Feb 1954

Editorial

THIS month Australia welcomes to her shores Her Majesty Queen Elizabeth II and assures her of continued loyalty and affection.

It will be a great day in Sydney when the Gothic steams up the Harbor, acclaimed by a vast crowd of people afloat and ashore. It will be an historic occasion when Her Majesty lands at Farm Cove to spend an all too brief period with her subjects in the Australian Commonwealth.

Although most of Australia will not be witnesses to the Queen's landing, there will be very few who need feel cut off from the happenings of the great day.

Australia's radio network, probably the largest per unit population in the world, has comprehensive and extensive plans to link up the nation for the occasion, commencing long before the Gothic actually passes through the Heads, and continuing throughout the day's festivities, as commentator after commentator takes up the story of celebration and gaiety.

It is certain that no other person in history will receive a welcome such as we will give our Queen. Public participation will probably be so vast as to suggest unprecedented problems of traffic handling.

Organisation to meet this position will be extremely difficult, and might well be impossible without radio communication links. Police, ambulance, transport authorities, even railways are all equipped with their own mobile radio services, to fit their facilities into a tight and speedy network. On the harbor various vessels equipped with radio will hold contact with shore stations, speeding up routine work, ready for any emergencies should they arise.

Newspaper coverage will lean heavily on radio communication. Instant linkage out to reporters and special writers will probably be possible in no other way, for journalists, although normally agile people used to getting around, find it just as hard as anyone else to penetrate a crowd of half a million people. So they will use radio cars and walkie-talkies, and with special picture-gram equipment, send pictures of the landing direct to their offices and the world through radio channels.

Radio is a willing servant, with almost limitless powers. In recent times, it made possible a calamitous war. This month we will see what it can do to make a happy occasion even happier, and to link up the entire nation in welcome to a truly Gracious Queen.

John Moyle

INDEX

Gun Marks "Blips" On CRO Face. 3
Phone Traffic By SHF Radio. 4
"Flying Shape" Breaks Record. .. 9
"Starfire" Is Near Automatic. 10
Noise Is Useful—Sometimes! 13
Why Do The Breakers Break? 14
Technical Review. 19
News And Views. 25
"Wide-Band Six" For 1954. 28
Phase Shift Distortion Test. 37
Let's Buy An Argument. 42
Aids To Industrial Electronics 52
The R&H Telephone Amplifier 56
Here's Your Answer Tom! 68
Calibrating Your Oscillator 70
From The Serviceman Who Tells .. 76
A Reader Built It! 82
Electro-Flash Design Trends 84
Trade Reviews And Releases 86
Off The Record 94
Record News From Overseas 97
Short-Wave Notes 98
The Ham Bands 99
Make This Plastic Deflector 105
Answers To Correspondents 110

RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Mounted on top of a tower near Sublime Point on south coast of NSW, this aerial array is part of a radio link between Sydney, Wollongong and Goulburn. See the story on page 4.

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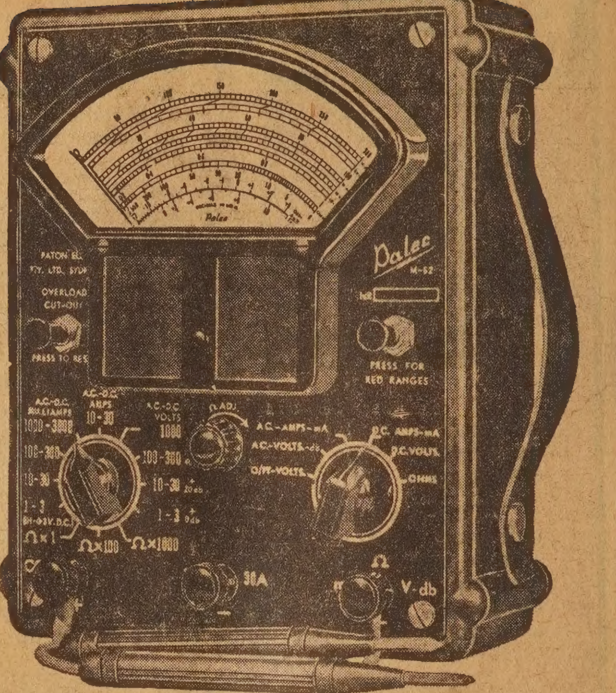

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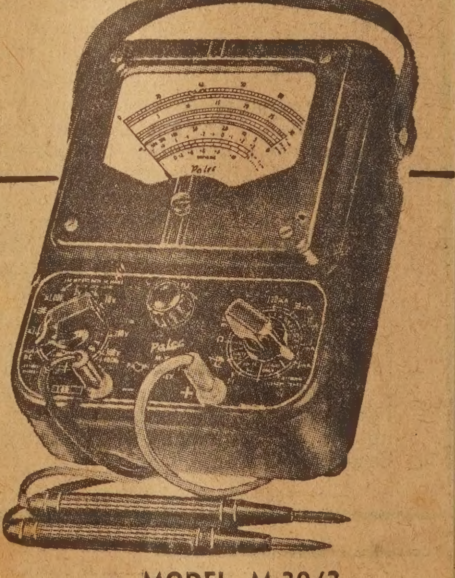

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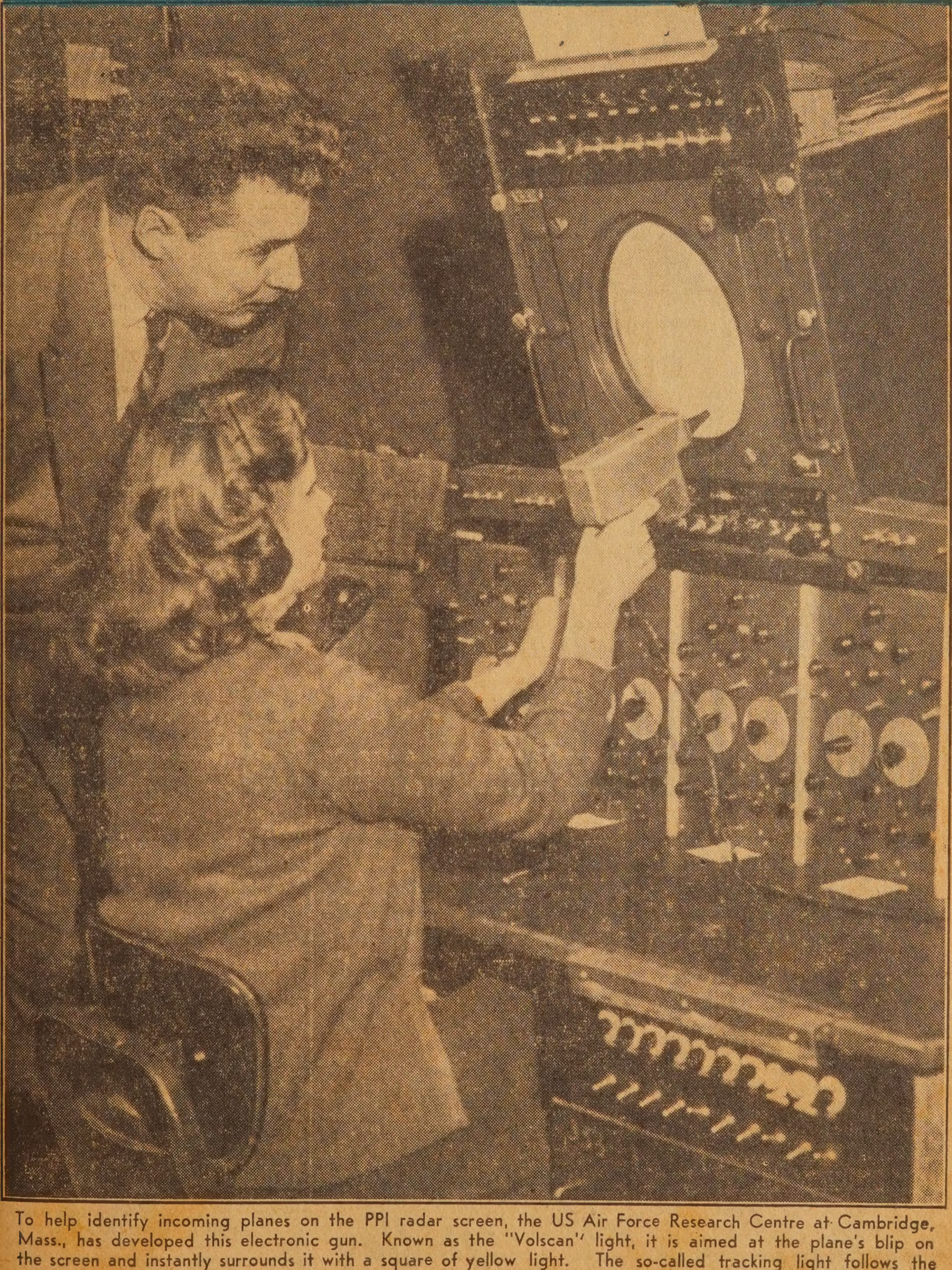
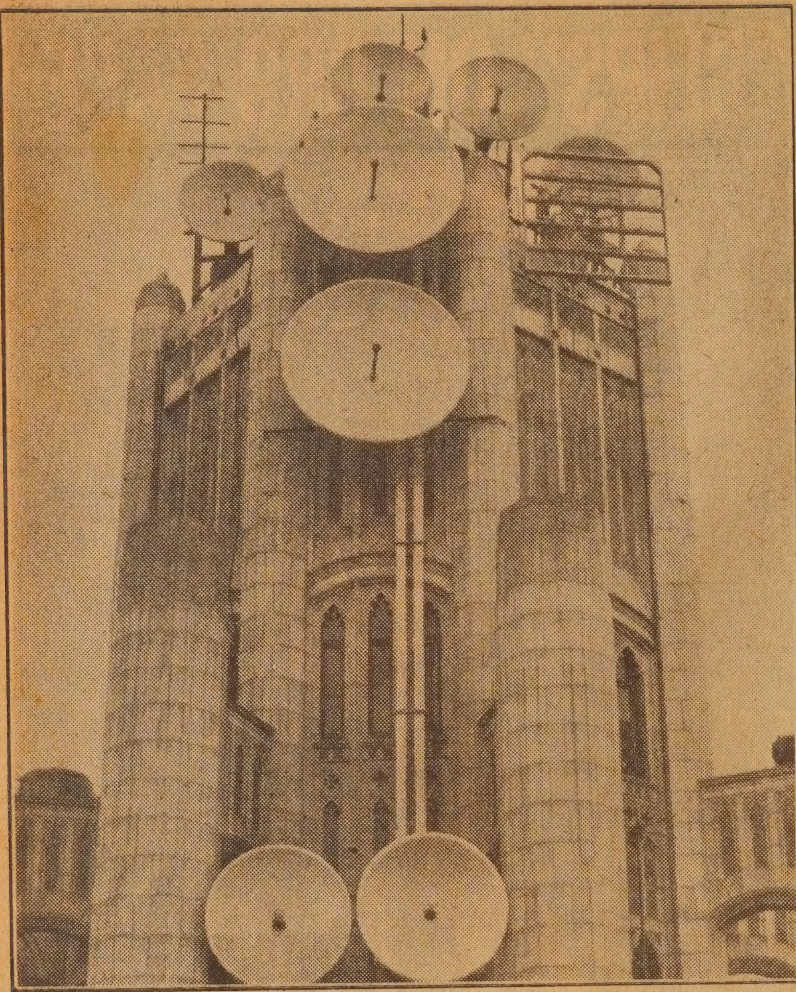
GUN MARKS "BLIPS" ON CRO FACE



To help identify incoming planes on the PPI radar screen, the US Air Force Research Centre at Cambridge, Mass., has developed this electronic gun. Known as the "Volscan" light, it is aimed at the plane's blip on the screen and instantly surrounds it with a square of yellow light. The so-called tracking light follows the plane as it nears the base.



Aerials for the Sydney terminal are situated on a tower about 180 feet above the street level. The six smaller aerials are for the two 4,000 Mc systems which connect with Goulburn via two relay stations allowing for a total of 60 telephone conversations. The two larger dishes are for the 2,000 Mc pulse modulated system to Wollongong. One of the Yagi arrays for the 160 Mc system to Wollongong can be seen at the top left.

PHONE TRAFFIC BY SHF RADIO

Have you used a trunk line telephone lately? Did it ever occur to you that your voice may have been transmitted by radio rather than the usual wired circuits? Even if it had, you wouldn't have detected the difference. Highly efficient radio trunk line services are now in operation between Sydney and two large centres and more are contemplated. These services may well lead the way to microwave television links between cities.

by Maurice Findlay

WITH an eye to future developments in communication in this country, engineers of the Postmaster General's Department are at present working on equipment which makes use of radio waves at very high frequencies to do the job of the usual wire circuits supported by telephone poles.

Experiments are still going on but they are expected to prove that radio circuits will, in many instances, provide better telephone facilities at lower cost. Frequencies at present in use are in the VHF and UHF ranges as well as SHF. (VHF, UHF and SHF are abbreviations for Very, Ultra and Super High Frequencies respectively. In the same order the ranges are 30 to 300 Mc, 300 to 3000 Mc and 3000 to 30,000 Mc.).

As a conscientious taxpayer, your first question will probably be, "Why spend a lot of money on complicated radio equipment and employ clever engineers (at appropriate salaries) when the telephones work perfectly well with ordinary wire circuits?"

There are several answers. To support a trunk telephone line a wooden, or perhaps metal, pole is required about every 44 yards. A small division sum will show that 40 poles are required for each mile of line. For a telephone line between two cities 100 miles apart that works out to about 4000 telephone poles.

If you are more adventurous you can translate the telephone poles into £sd. Say, for the sake of round figures, that the poles are worth £5 each when installed in the ground.

FIGURES MOUNT UP

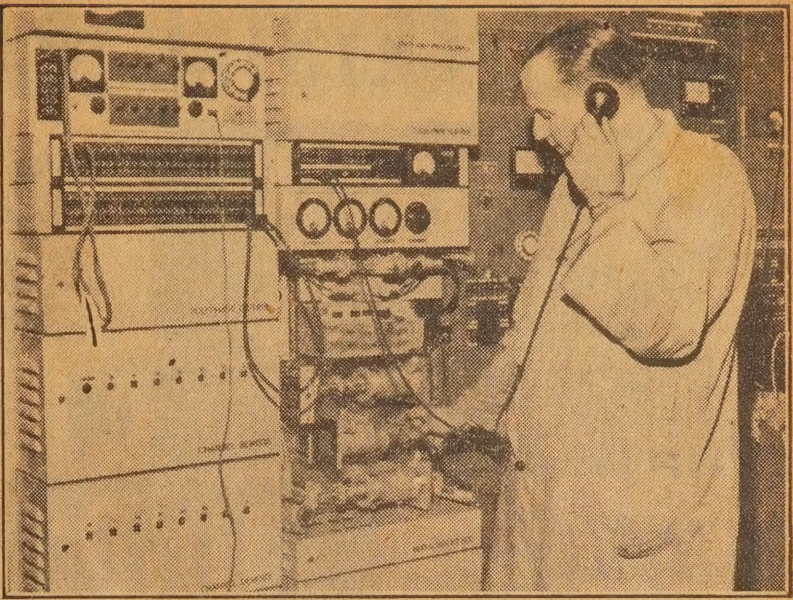
If you use the same brand of arithmetic as we do, you will be up to £20,000. That is the cost of the poles alone. No mention has been made of the cost of the wires, insulators and sundry devices which are essential to maintain the high standards of efficiency and reliability which are insisted on by telephone subscribers.

Even if you are in the fortunate position of being able to write a cheque for £20,000 you can't get a contracting firm to erect a string of telephone poles 100 miles long and clear an effective fire-break on either side of the line on the instant. It may actually take years and in the meantime the load on the lines is increasing so that they may actually be out of date before they are finished.

By means of a number of clever circuits the telephone people are able to transmit a number of conversations on the one pair of wires.

For example, using the carrier telephone system which has been tried and tested over many years, it is common practice to transmit up to 30 quite separate conversations using only two wires. The techniques are so refined that telephone users at either end of the line have no idea that the same wires are being used to transmit other conversations.

It must be so, because secrecy is one of the essential requirements of any telephone system.



A P.M.G. technician working on the 23 channel 2,000 Mc equipment connecting Sydney with Wollongong. By frequency modulating the carrier directly an independent "order wire" is available for communication between terminal and relay stations. This equipment can be made to accommodate a dialling system if necessery so that direct dialling between cities is a possibility.

Carrier telephone equipment helps a great deal but with traffic rapidly increasing PMG engineers must be on the look out for other methods. Experiments have been conducted with coaxial lines for example. There are cases where coaxial lines have advantages and there they are used.

Developments are going on so that accurate information on the economics of different methods can be obtained but, at the moment, much interest is centred in radio links. They have undoubted advantages in many instances and it is hoped that the trials being given the systems in service at the moment will discover other advantages which are as yet unknown.

Even before the war, use was made of radio for trunk line services both in Europe and America. However, little development in the use of radio waves at very high frequencies had then taken place. The ordinary radio waves used for communication and broadcasting have characteristics which make them not particularly suitable for telephone work. Troubles were encountered with fading and it was difficult to confine the waves to a sharp beam, so that there were doubts about secrecy.

WAR RESEARCH

With the pressure of war, very rapid development in the use of radio waves at frequencies of the order of thousands of megacycles per second was made with the result that these waves can now be put to good use at relatively low cost.

In case you are not familiar with them, radio waves at frequencies of 30 Mc and above possess many of the characteristics of light waves The similarity becomes stronger as the frequency is increased.

At frequencies of the order of 100 Mc and higher the waves can be concentrated into beams with aerials sufficiently small to be laid on the kitchen table. Above 1000 Mc extremely sharp beams can be formed with the aid of a parabolic reflector. A number of these reflectors, which look something like large dishes, can be seen in the photographs.

The parabolic reflector deals with radio waves in much the same way as a searchlight reflector deals with light waves. A small aerial takes the place of the carbon arc which is used in the searchlight. It is placed at the focus point of the reflector.

Waves leaving the aerial are reflected in such a way that they all travel in the same direction in a narrow beam. The highly polished reflector as used in a searchlight is not required and in general any metallic surface will do the required job. For lower frequencies wire mesh can be used.

One of the big advantages of the concentrated beam is that little of the energy generated by the transmitter is wasted by being sent in directions other than that of the receiving aerial. Reliable communication can be effected by transmitters delivering very low power.

Although the radio waves in use have many of the characteristics of light waves, they are practically unaffected by atmospheric conditions. There are special cases where the beams are bent by varying temperatures at different altitudes but design features can be incorporated which ensure good communication at all times.

In heavily timbered country subject to bushfires, radio links have important advantages over wired circuits.

In the latter case there is always the possibility of the poles being burnt down and breaking the wires. It is likely that these will be the very wires required to carry directions to and from the men fighting the fire!

Telephone wires are similarly vulnerable in areas subject to floods.

Radio repeater stations are necessarily on high ground and there is every likelihood that they will provide normal communication throughout the emergency.

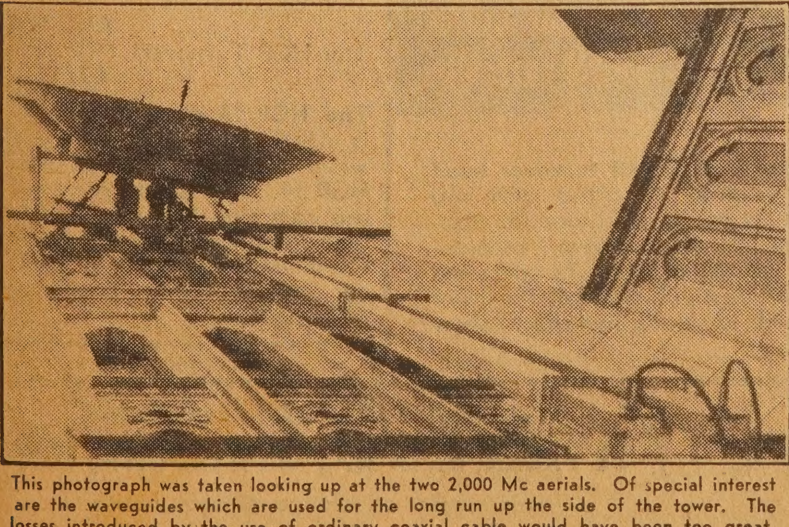
With radio links replacing the wires, there are no poles to be burnt down or washed away and communication is unaffected by smoke, flames or storms. It is relatively easy to provide effective fire breaks around terminal stations which may be situated at distances of 30 miles or more apart, depending on the terrain.

EMERGENCY POWER

The primary power required by the terminal stations is relatively small, so that even if power supply lines fail, a small emergency power supply which comes into operation automatically can keep them in operation. Bearing in mind the nature of the Australian countryside, this may well be a deciding factor in determining the design of future installations.

At the present time, radio trunk line services are in operation between Sydney and Wollongong and Sydney and Goulburn, as well as in other parts of NSW. In Sydney, the parabolic aerials are mounted high up on the Grace Building in York St. They are directed to a repeater station which is situated at Maddens Plains on the Princes Highway just north of Bulli Pass and about 30 miles south of Sydney.

From Maddens Plains signals are beamed down to Wollongong, thus connecting that city with Sydney in two hops. From Maddens Plains another bank of aerials carries the service to Mount Gibraltar near



This photograph was taken looking up at the two 2,000 Mc aerials. Of special interest are the waveguides which are used for the long run up the side of the tower. The losses introduced by the use of ordinary coaxial cable would have been too great.

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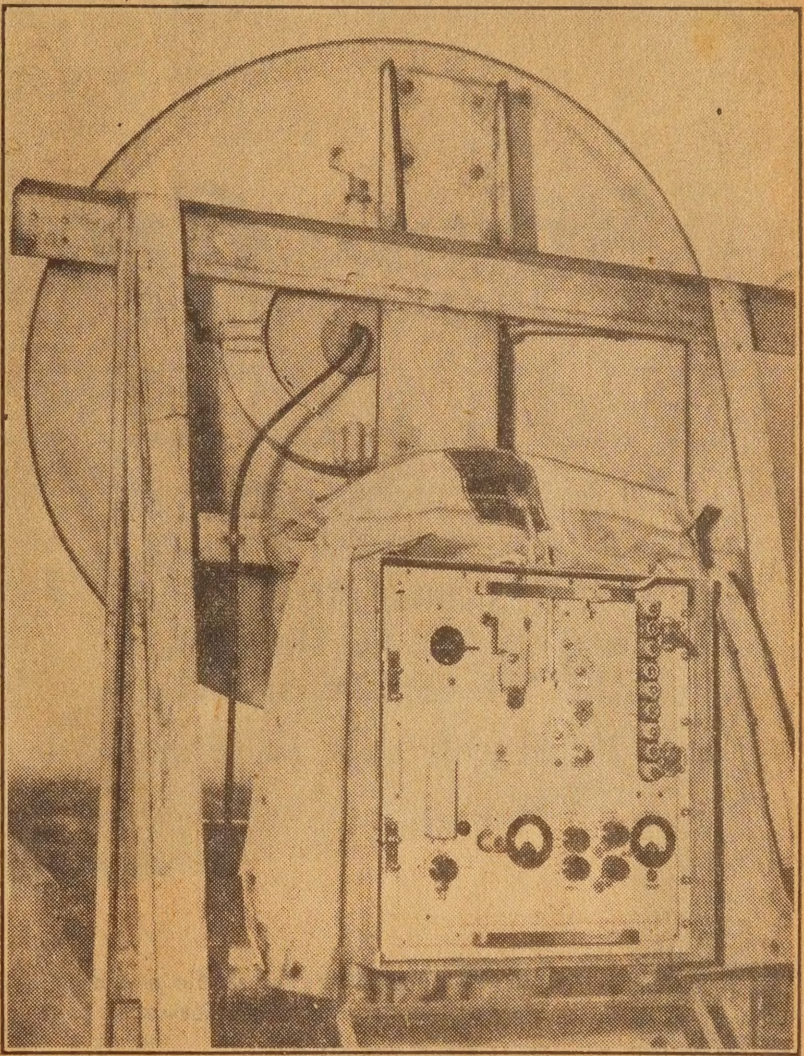

One of the 4,000 Mc transmitters at the Sydney terminal. It is mounted directly behind the parabolic aerial because of the excessive losses in transmission lines at these frequencies. The electronic equipment is mounted in a sealed metal box which is kept at a constant temperature. Weatherproofing covers have been removed for the photograph.

Bowral. It is relayed from this point to Mount Gray, a few miles from Goulburn, thus completing the journey from Sydney in three stages.

There are two separate systems linking Sydney and Goulburn, each operating in the band between 3850 Mc and 4250 Mc. These systems use the smaller of the parabolic reflectors shown in the photographs. At each terminal station three reflectors are used for each system, one for transmitting and two for receiving. The two receivers are arranged so that, in effect, the better signal is passed on to following equipment.

FREQUENCY STABILITY

The 4000 Mc carriers are generated by reflex klystrons which deliver about 100 mW of radio frequency power. The output of the klystrons is referred to a resonant cavity which is used as a frequency standard and should the frequency shift from its normal allotment, it is brought back automatically by electronic means.

Following the approved practice for frequencies of this order, the signal from the receiving aerial is fed into a crystal mixer. This is followed by an intermediate channel at 32 Mc. The design of the equipment is such that a transmitter and a receiver may be operated with a frequency spacing of 24 Mc at 4000 Mc.

Ultimately, the system operates in conjunction with the well-known "carrier" telephone equipment in which a band of intelligence extending from 50 cps to 150 Kc can be used to accommodate 30 telephone conversations each extending from 300 cps to 3.4 Kc.

The operation of the carrier telephone equipment warrants quite a story on its own account but briefly it consists of frequency conversion and filtering devices which generate single sideband suppressed carrier signals for each of the voice signals. These signals are regularly spaced, with appropriate guard spaces in between, throughout the intelligence band between 50 cps and 150 Kc.

COMPLEX MODULATION

Technical considerations made it undesirable to modulate the 4000 Mc carrier directly with the intelligence band. Rather the intelligence is used to frequency modulate a 1 Mc sub-carrier which, in turn, frequency modulates the 4000 Mc carrier. A frequency of 4000 Mc, incidentally, is equivalent to a wavelength of 7.5 cm.

At the receiving end an intermediate frequency of 32 Mc is extracted from the mixer, amplified and passed on to a frequency discriminator which recovers the 1 Mc subcarrier. This is fed into another discriminator which delivers the 50 cps to 150 Kc intelligence band. The latter is amplified and passed on to the ordinary wired circuits where it is handled by the normal carrier telephone equipment.

With the equipment at present working between Sydney and Wollongong it is possible to handle 28 conversations simultaneously. The smaller system operates in the 150 Mc to 170 Mc band and is frequency modulated. The associated carrier equipment enables five calls to be handled by the equipment at one and the same time.

The second system linking Sydney with Wollongong operates in the 1750 Mc to 2300 Mc band and is of particular interest in that it employs a technique known as pulse-time modulation, otherwise known as pulse position modulation. A battery of complicated equipment generates a train of pulses each less than a quarter of a microsecond in length.

One pulse is sent for each caller and a special arrangement of the pulses allows the receiving equipment to be synchronised with the transmitter. When the caller speaks the time of emission of the appropriate pulse is varied in relation to the other pulses in sympathy with his voice.

The technique of recovering the intelligence from the pulse modulated carrier is highly complicated but appears to offer advantages over other methods of modulation and detection.

The 2000 Mc equipment uses the larger of the parabolic reflectors appearing in the photographs and the power output during the pulses is 75 watts. However, the average power output is only 3 watts.

The other aerials you may notice in the photographs consisting of a dipole with a number of directors and reflectors (known as the Yagi array) are for the 150 Mc to 170 Mc system. Some experimental work with aerials for this band has been undertaken and a stacked rhombic array is at present in use at Maddens Plains. Transmitter powers between 3 and 50 watts have been tried, depending on the path over which communication is required.

Some of the equipment in use was originally purchased from American manufacturers while a large portion of it was actually manufactured in this country. However, with equipment of this nature the design does not end with the purchase by the user and PMG engineers are con-

(Continued on Page 83)

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"FLYING SHAPE" BREAKS RECORD

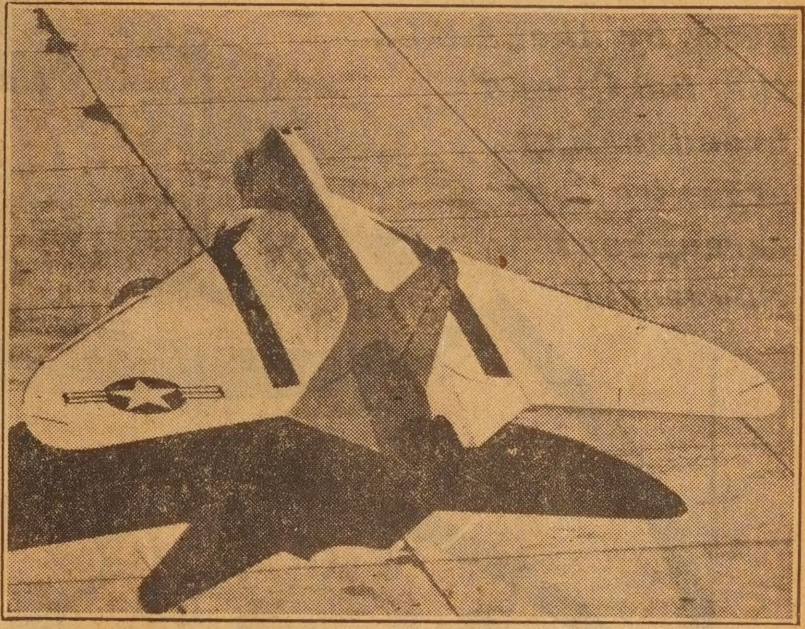
The US Navy is proud of its latest jet fighter, the Douglas XF4D-1 "Skyray", which has earned for itself the affectionate title of "Flying Shape". It proved itself fast enough to break the world speed-record, yet is slow enough to land safely on a carrier.

THE problem of designing aircraft to operate over such an enormous speed range has plagued designers ever since the carrier emerged as a tactical fighting ship.

While high top speed and low landing speed are desirable characteristics for any plane the problem is multiplied many times in a carrier-borne aircraft, which has to be sat down on a woefully small, heaving deck.

The fact that a plane, once aboard, must also be capable of folding its wings for rapid stowage only adds to the problem.

US Navy pilots Comdr. M. U. Beebe and Lt. Comdr. J. B. Verdin are running the carrier qualifying trials for the "Skyray". Verdin set the 753.4 mph record.



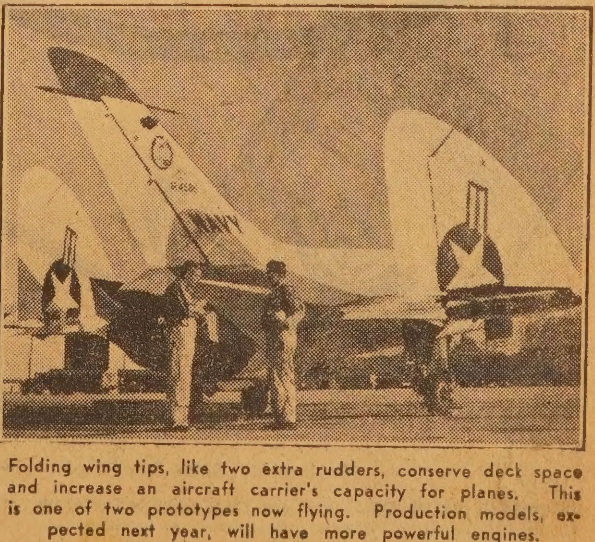
Modified-delta design of the first carrier-type plane to hold a speed record makes it a highly manoeuvrable craft. Plane has a wingspan of 33½ft., length of 50ft. US and Britain are developing other fighter and bomber deltas.

At the beginning of World War II, carrier-based planes were completely outclassed by land fighters and the gap was still quite wide at the close of hostilities.

But expedience and experience have brought to light a lot of new tricks in both ship and plane design. New-type decks, assisted take-offs, better braking gear, better methods of control have all played their part in closing the gap between carrier and land-based aircraft, at least in the realm of conventional interceptors and attack planes.

While the "Skyray's" record has since been lowered by its own teammate—the Super-Sabre—it remains in the very top bracket of the world's piloted interceptors.

Landing signal officer indicates that Skyray is making a correct approach as it slows to minimum controllable speed, probably about 125 mph. This simulated carrier landing is on a specially equipped runway which has arresting gear as on carrier.



Folding wing tips, like two extra rudders, conserve deck space and increase an aircraft carrier's capacity for planes. This is one of two prototypes now flying. Production models, expected next year, will have more powerful engines.

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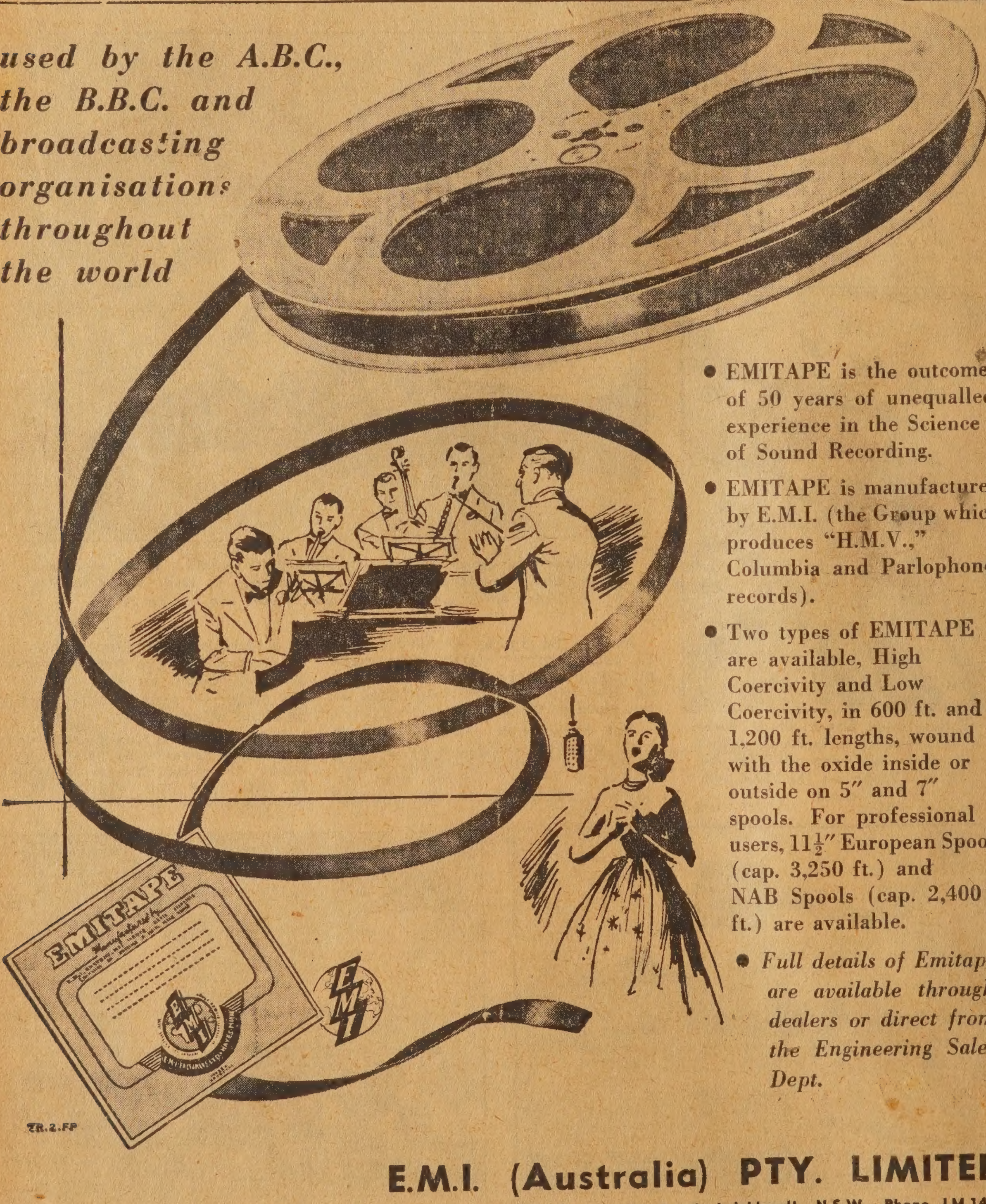

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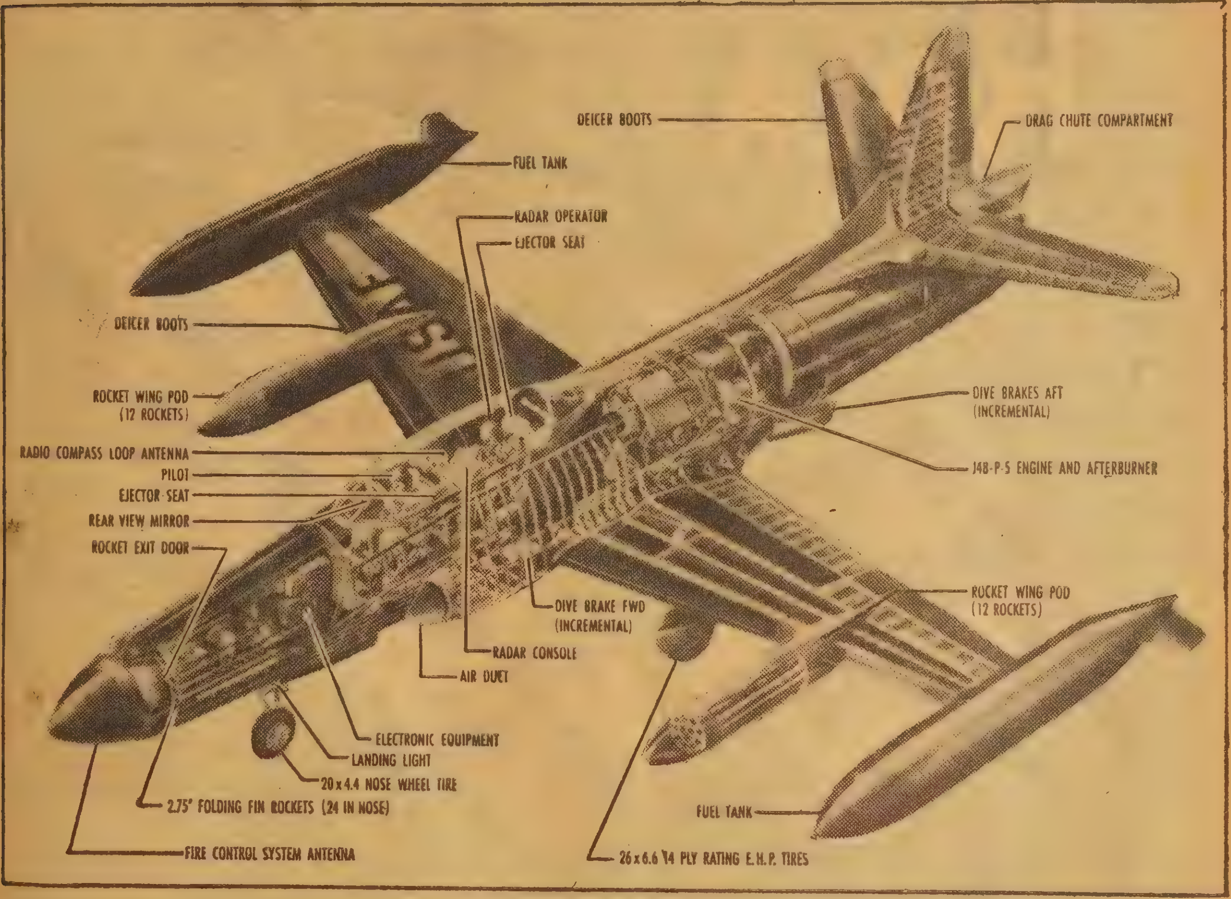
"STARFIRE" IS NEAR AUTOMATIC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The Lockheed Co. has just released "x-ray" details of their "Starfire" jet interceptor. Designated F-94C by the US Air Force, it is nearly automatic in operation. It carries an automatic pilot, electronic computing devices and automatic rocket-firing equipment which permit it to fly and fight in any weather.

ITS pilot and radar operator serve only as monitors for the jet interceptor's automatic flight and fight equipment once its radar "locks on" the target. Starfire crews can destroy even the largest enemy bomber without seeing the target, according to the US Air Force.

Built in the vast 11-million sq ft factories of Lockheed Aircraft Corporation in Burbank, Calif., the aircraft represents a large step toward future unmanned aerial vehicles for the defence of the free world, the company disclosed.

SPECIAL RESEARCH

Lockheed president Robert E. Gross, recently announced the establishment of a complete new division to specialise in developing and producing pilotless aircraft. Lieut.-Gen. Elwood R. Quesada has been designated vice-president and general manager of the newly established division.

Mr. Gross has outlined transition to aerial defence vehicles that will fly without pilots, as taking place by stages of (1) piloted fighters which have been conventional in military operation, with the pilot aided by instruments only; (2) semi-automatic aeroplanes such as the Lockheed F94C Starfire, in which a pilot takes off and receives direction from ground radar operators until the fighter nears its target, at which time the plane's automatic equipment takes control; (3) fully automatic vehicles which will take off, change speed and direction during flight, to intercept invading aircraft and missiles.

The new Lockheed fighter carries 1200lb of electronic equipment. As soon as the plane is in radar range of its target, automatic electronic equipment flies the aircraft, computes the position of the target, and fires rockets automatically. The fighter carries no guns. A ring of 24 rockets of 2.75in diameter surrounds the nose of the plane, and 24 additional rockets of equal size fit in the two wing pods.

Although the exact speed of the Starfire has never been revealed, the US Air Force has admitted that it flies faster than 600 mph. Air force pilots have reported that it flies supersonically in dive tests, making it the first aeroplane ever to fly a passenger faster than the speed of sound. It carries a parachute brake for use in landing.

FOURTH OF SERIES

The Starfire is the fourth major jet model in the family of the famed F80 Shooting Star, winner of the world's first all-jet air battle, and leader in developments which brought Lockheed to its position as the world's largest manufacturer of jet aircraft.

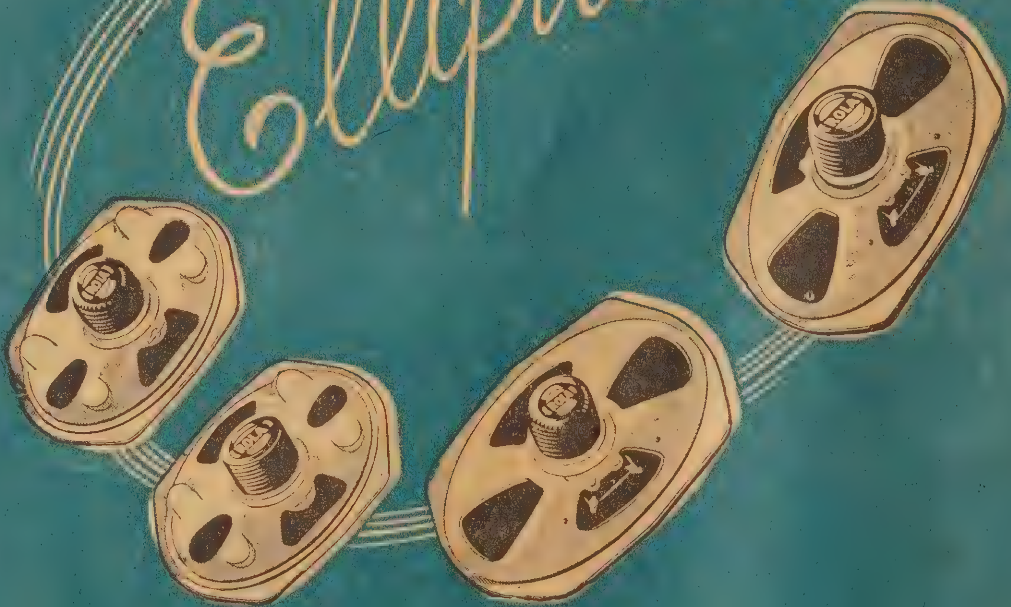
Lockheed also builds T33 jet trainers, P2V Neptune patrol planes, Super Constellation transports, C130 freighters, with additional advanced military types now under development.

2500 mph WINDS

A SUPERSONIC wind tunnel, billed as the world's most powerful, now is under construction at the Arnold Engineering Development Centre, at Tullahoma, Tenn.

To be used by the air force in developing future planes and guided missiles, the tunnel will be fed by five giant compressors running in tandem. The finished machine will generate 216,000 horse-power and produce gales of 2500 miles an hour.

ROLA Ellipticals



SPECIFICATIONS

MODEL	POWER HANDLING CAPACITY (watts)	CONE	FUNDAMENTAL DIAPHRAGM RESONANCE c/s	FREQUENCY RANGE c/s	VOICE COIL IMPEDANCE Ohms at 400 c/s	PRINCIPLE DIMENSIONS (Inches) Overall	Front to Rear	Baffle Opening
5-7H	4	F86	115	110-6,000	3.5	7 1/8 x 5 1/8	2 7/8	6 1/4 x 4 1/8
5-7L	5	F86	115	110-6,000	3.5	7 3/16 x 5 1/8	3 1/8	6 1/4 x 4 1/8
6-9H	4	F70	115	110-5,500	3.5	9 7/32 x 6 11/32	3 5/16	8 1/4 x 5 1/2
6-9L	5	F70	115	110-5,500	3.5	9 7/32 x 6 11/32	3 1/2	8 1/4 x 5 1/2

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NOISE IS USEFUL—SOMETIMES!

Most people look upon noise as a nasty racket and nothing else. It is more than that. Noise can break glasses, make you sick and wear you out. If its waves are regular it becomes sound. It can fasten metals together, make chocolate, mix oil with water and wash clothes to perfection.

SOUND is now an important new tool for industry.

Noise is the result of alternate periods of compression and rarefaction in the atmosphere. It has many curious features. It makes air warmer. It is quite easy to measure the rise in temperature of a room as a result of a distant rifle shot.

A man addressing an audience in London can be heard over the radio in Australia before his voice reaches the end of a long lecture hall in England.

Noise reflection is an important property. Thunder has its "rattling" sound because the waves of noise bounce off clouds, houses and trees. An echo is only reflected sound. Try putting your loud-speaker in a corner so that the walls act like the sides of a trumpet. It will often change the character of the reproduction quite markedly, due to reflections and echoes.

SOUND REFLECTIONS

Reflected waves are very complicated and easily "distorted" by a very loud radio set.

Too much volume from your loudspeaker invariably ruins the sound, quite apart from its unfortunate effect upon the neighbors.

Music can be partly absorbed and turned into heat, leaving the rest to be reflected inaccurately.

There are some buildings in London where high notes are almost entirely lost because the wrong material has been used to decorate the walls. Even in an ordinary room, rearrangement of curtains or books on the wall can affect music.

Noise can be an extremely serious thing to human beings. No one can get used to it. When we say, "I used to live in the country, but I soon got used to the noise of London," we are talking nonsense.

The truth is we can only resist the attack of noise by putting out energy, which ought to be better spent.

BODY "HEARS"

Noise enters the body all over, not merely by the ears, and it is most lucky for us that civilisation has reduced our sensitivity to it.

Birds listen for worms many inches down in the earth. The reverse is true also, and, if this is tested by putting worms in a box with a glass side, they can be seen to stop wriggling as soon as a bird's foot lands on the grass.

It would be terrible if, with the brain of a human being, you had the ears of a bird. Sitting on the greenest grass would prove a most distressing experience, with nasty rattlings underneath you all the time!

I have been photographing noise since 1910, not by film recording, but audiometrically. Everyone laughed in those days when London sounded and "looked" like a series of bumps: Now it is just one sustained crash, and it has made us more nervous in many ways.

Wave shapes are interesting, for one can see the staccato yells of a Hitler and compare them with the wave form of someone more gentle.

A "pure" voice, about which some of us speak, would sound unbearably boring. It is the little "twiddles" in the wave which give a voice its attractive character.

By

Professor A. M. Low

Many years ago the BBC broadcast a joke about a riot in London. Hundreds telephoned to know if it was true. . . . It was their receiving sets which smoothed out the lilt which clearly said, "This is a joke," and gave the whole speech the solemn, rather monotonous tone of an announcement.

It is difficult to think of a noise I have not photographed. Guns, Dame Nellie Melba, Hitler and worms and so on. I had one case of a man who could not sleep because of twittering birds, and another where a parson was justifiably annoyed by jazz, which bounced off a local reflecting wall and crept through his study window.

Travel is an important example of the influence of noise. The passenger's "ideal" is that he should not know that he is travelling.

It is important that the noise should not be of a type to interfere with normal speech. It should not be of extremely high pitch either, nor must it be only barely audible, if we are not to be kept on the alert all the time.

It is easy to work in the neighborhood of a waterfall, but the far lesser noise of a small mosquito can ruin our temper in a few hours.

Now that we shall soon be taken overseas for a day's swimming, some recent tests to find out why some plane trips are so quiet and free from exhaustion are very interesting.

People have been led to believe that all flying is unbearably noisy. This is by no means true. The BOAC trans-Atlantic trip is more quiet than most tube trains to which we fondly believe we have become accustomed.

It is very nearly as quiet as a good carriage in an open-air corridor train, with the excellent result that everyone arrives at their destination without exhaustion and without the feeling that it would be a blessing to smash the crockery or kick the cat.

The sounds experienced do not interfere with conversation, and passengers can talk in a normal voice over a small table. Better still, the frequencies are not those which hit your body with a jerk. It is easy to arrive fresh and easier still to sleep all the way.

I have only to look at my records to see how much louder is the passenger who said "Oh" close to my ear then the over-riding noise of the aircraft.

LOUDER NOISES

Barking dogs, trams, and rattlings are all vastly more powerful than the note of good air travel. Even the low notes are not bad, however much as they might annoy a worm. High squeaks are nearly non-existent, to the disappointment, perhaps, of any bats which might be listening.

Bats steer by the reflection of high-pitched sound in the darkness, just as we use radar to guide ships.

The net result of flying tests is that no one need worry about noise in a properly protected aircraft. People on the ground have far more cause to complain.

Remember that all our personal noises are unwanted by other people, that they waste energy, are the best present-day example of bad manners, and are very, very rude. There is no need at all to say, "Oh" five times as loud as any other noise in the neighborhood; or for impertinent loud-speakers in quiet streets to tell us how we should vote.

AN electronic device that schedules airplane landings at bustling airports has been devised in the U.S.

Designed to cut the traffic snarl in skies over airports, the electronic machine figures out when a certain airplane should arrive at the airport. Then it determines whether any other plane is scheduled to land at the same time.

If the airstrip will be in use at the scheduled arrival of the plane, the machine calculates a slight detour for the pilot to fly. The detour will delay the plane's arrival until the first moment the landing field is open. The detour path is relayed by radio to the pilot.

This eliminates the conglomeration of planes "holding" at certain altitudes over the airport while waiting for landing instructions. Theoretically one landing every 30 seconds can be made at airports equipped with the device, provided the field can be cleared of passengers and plane.

WHY DO THE BREAKERS BREAK?

The study of the waves and currents of the ocean had a peculiar fascination for scientists for centuries, but it is only in recent years that a more complete understanding of them has been possible.

by Calvin Walters

Riding the breakers, or just surfing, is one of Australia's most popular pastimes. Have you ever wondered why waves behave as they do or what difference there is between a "shoot" and a "dumper"?

THE study of the origin and effects of ocean waves and currents was intensified during the last war to provide data for beach landings on enemy coasts.

Most of the studies were conducted by Dutch, Norwegian, German and American scientists, and the facts brought to light were of considerable importance in planning and carrying out beach-landing operations.

Most of us in our excursions to the beach admire the waves for their beauty or their utility in keeping us cool on a hot day.

GREAT FUN

We revel in the act of shooting a big breaker or watching the surfboard rider come in on the crest of a big, foaming wave.

On the other hand, waves can become fearsome monsters, ready at any moment to take us out to sea where we must await the coming of the life-saver.

Very few of us stop to ask where the waves and currents of the ocean originate. As they have interesting characteristics, it is well worthwhile doing a little investigating.

It would possibly be of interest to a half-drowned surfer who has just been rescued to know the origin and scientific characteristics of the wave that got him into all the trouble.

It would be a great comfort and a cause for meditation to one caught in a rip. During the long, lonely wait for the coming of the rescuer he could meditate on the wonders of the mighty deep, and when he is rescued he would be more appreciative of the efforts of the life-saver, thereby inspiring a decision to donate a lifeboat or something to the local surf club.

Investigations during the war discovered some peculiar things about waves. The results of this research enabled the Allied commands to conduct amphibious warfare with greater safety and certainty than was possible before.

In order to carry out these operations it was necessary for the commands to be able to predict sea and swell from weather maps, forecast the breakers and surf from the known swell conditions and estimate the surf conditions and depths from the shore by means of aerial photos.

Before proceeding to a more detailed discussion of waves and currents, there are certain definitions which it is necessary to understand.

The development of a wave in the ocean proceeds through three stages. The most prolific cause of waves is the wind, and waves produced this way travel far beyond the area where they were first formed.

SEAS AND SWELL

Where waves are directly under the influence of the wind, they are called SEAS. Where they travel beyond the influence of the wind, they are called SWELL.

Seas are usually confused and irregular, but as they proceed farther from their source and become SWELL, they become smoother. As the swell approaches the shore and passes over shallow water, it again becomes confused and irregular until it approaches the breaker line. The waves are here called SURF, so we now have traversed the three stages of a wave's development, namely, SEA, SWELL, and SURF.

A few more definitions and we will be on our way. The LENGTH of a wave is the distance between two crests. The HEIGHT is the vertical distance from the trough to the crest. The time taken for two crests to pass a given point is called the PERIOD of the wave. The speed of the forward movement of the crest is called the VELOCITY.

Having now digested the fundamentals, we are in a better position to understand what is to follow.

About a century ago it was discovered that in deep water the velocity of a wave in knots is equal to three times the period in seconds.

This means that a wave whose crest takes five seconds to pass a given point travels at a velocity of fifteen knots in deep water.

MATHEMATICS!

Another fact discovered at the same time stated that the LENGTH of a wave is five times the square of the PERIOD. So that a wave with a five second period has a length of 125 feet.

These two basic rules were those on which most of the research was based, and it was soon apparent that there was a definite relationship between the high waves, wind velocity, the fetch or stretch of water over which the wind was blowing and the duration or length of time the wind was blowing.

The greatest waves are found in the southern ocean surrounding the Antarctic region because there the wind blows over a greater distance, and the wind velocity is mostly high and of longer duration. Waves produced by wind rarely exceed 55 feet in height. This is due to the fact that there is an absence of large areas with very high wind velocities, and furthermore when a wave tends to be higher than 55 feet it has its crest blown from the top by the force of the wind.

During the forward motion of a wave the water particles move in a circle, but for each revolution there is a forward movement. The idea can be grasped by imagining a hoop being bowled along the ground. The rim of the hoop can be likened to the outside surface of the wave. The space inside the hoop would represent the water. This water moves in circles, but also travels forward.

CIRCULAR MOTION

The water is moving forward in the crest of the wave (top of the hoop) and backwards in the trough of the wave (bottom of the hoop).

In the front of a wave, therefore, the water is sinking (front of the hoop), and at the rear of the wave the water is rising (back of the hoop). This is an important point and helps to understand the breaking of a wave described later.

At the surface, the diameter of the circle described by particles of water is equal to the height of the wave.

It has often been asked how far below the surface the action of a wave is felt. It has been found that at a depth equal to one-half the wave-length of the wave, the wave action almost ceases. As it is rare that the wave-length exceeds 1000 feet, it follows that the greatest depth at which action is felt is 500 feet.

But as the vast majority of waves have a much shorter wave-length, the average depth at which water is agitated is very much less than this. This explains why fish and deep-sea divers can work below the surface of a comparatively rough sea with perfect safety.

REALLY GET AROUND

The velocity and period of waves increases with their height and the period of a wave increases the further it progresses from its source of generation. On the other hand, the height of a wave decreases the farther it travels. Some waves travel distances of 5000 miles.

There is an old saying and belief that the seventh wave is always the largest. This has been proved to be nothing more than a myth. Those who fish from rocks with this belief in mind could be nicely trapped if they relied on the counting of waves for their safety.

It is a fact that the largest waves of a series often arrive in groups after a period during which there has been a succession of small waves, but these periods are extremely erratic. Very often large waves may only occur once or twice during the day.

This is what happens when breakers decide to break in a different sense. Heavy seas carried away the complete sea-wall and beach-front at this popular resort in NSW.

The most common occurrence is for several larger waves to come in a group followed by an interval during which there are a large number of small waves. For this reason landing craft found it advisable to wait until several large waves have passed. Then, after the first small wave, one could be assured that there would be a fairly long interval with small waves, during which it was safe to land.

Wave heights near coasts vary from several causes, and these can be observed by anyone standing on a beach, particularly near rocks.

Interference between waves from different parts of the same wind storm or between waves from different winds may cause variations of height.

If two crests arrive at a point at the same time, the wave will be high. Conversely the arrival of a crest of one wave at the same time as the trough of another will result in a small wave by cancellation.

Observers on the shore will notice that out to sea the waves are often moving at right angles to the beach or coast. How is it then that the waves near the coast or beach come in parallel to the beach?

This is due to the retarding effect of the shore on the end of the wave near the coast. It is as though the shore holds back or brakes the shore end of the wave thus causing the wave to swing round as a whole with the shore as a pivot.

The formation of a breaker from a swell or sea is an interesting phenomenon.

During the wave's progress toward the shore, it reaches a point where the depth of water below is equal to one-half the wavelength of the wave. As mentioned above this is the greatest depth at which wave action is felt.

The water becomes shallower as the wave progresses and the bottom influences the wave more and more. The orbit of the wave becomes more elliptical instead of circular, because of the retarding effect of the bottom. The wave-length, therefore, becomes shorter, but the period of the wave remains the same. Thus the velocity decreases and the crest of the wave assumes a humped up appearance.

CREST ANGLE

When the forward motion of the water particles at the crest of the wave becomes greater than the forward motion of the wave as a whole, it will break. It has been found that this will happen only when the crest angle becomes less than 120 degrees. This crest angle is obtained by runing a line down the steepest slope of the wave on each side and continuing it out the top. The point where two lines meet is the crest angle.

While the breaking of a wave is related to its height and the depth of the water, it is also influenced by the nature of the wave and the direction and force of the wind.

There are waves of the type where

Going, going, gone? No not quite! The ship is merely hidden behind a huge wave. Or would it be a sea, or a swell?

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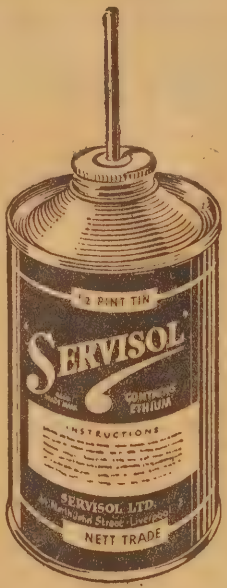

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the front assumes a concave shape, and the crest rolls over the top to fall down in a vertical direction. In this type of wave, commonly called a "dumper", the height of the breaker and the depth of water below is likely to be equal.

Waves which come in with a gliding motion and break evenly without the vertical plunge of the "dumper", usually have a greater depth below than the height of the wave. The latter waves are much sought after by "surf-shooters" or surf board riders.

The best surfing beaches are those where there is a convergence of waves caused by crossing wide submerged reefs.

PERIOD REDUCED

This is because the period of the wave is lengthened by being slowed down through the influence of the reefs. Long period waves give the most satisfactory surfing conditions owing to the fact that they pile or hump up at a great distance from the shore and do not always completely break until they have covered a great distance over the shallow bottom.

A word about rip currents and undertows should be of interest as there appears to be quite a misunderstanding of these phenomena among the general public.

When water comes in to the beach on a swell, it is necessary that it return whence it came. The word "undertow" has come to mean a strong current or flow of water beneath the surface. It is thought by many that an "undertow" will drag a person below the surface and take him out to sea.

There is no evidence to support this theory of very strong outward currents along the bottom, although there are slow moving outward currents. There are, however, strong outward currents at the surface or just below the surface, being found along all shore lines where large breakers occur.

These currents are often visible as a line of discolored water, and are referred to as a "rip".

WAVE DIRECTION

These "rips" are common on beaches where the waves come in parallel to the shore, but do not usually occur where the waves come in at any considerable angle to the beach, except in corners near headlands or where there may be obstructions such as wharves, &c.

The movement of the water in a rip usually takes place in the following manner. Feeder currents come in along the channels on the beach from both sides and then meet and turn outward toward the sea. This is called the neck of the rip, and is rarely more than 100ft across. When the water returns beyond the breaker line, the rip widens out and the water spins around in eddies. This portion is called the head of the rip.

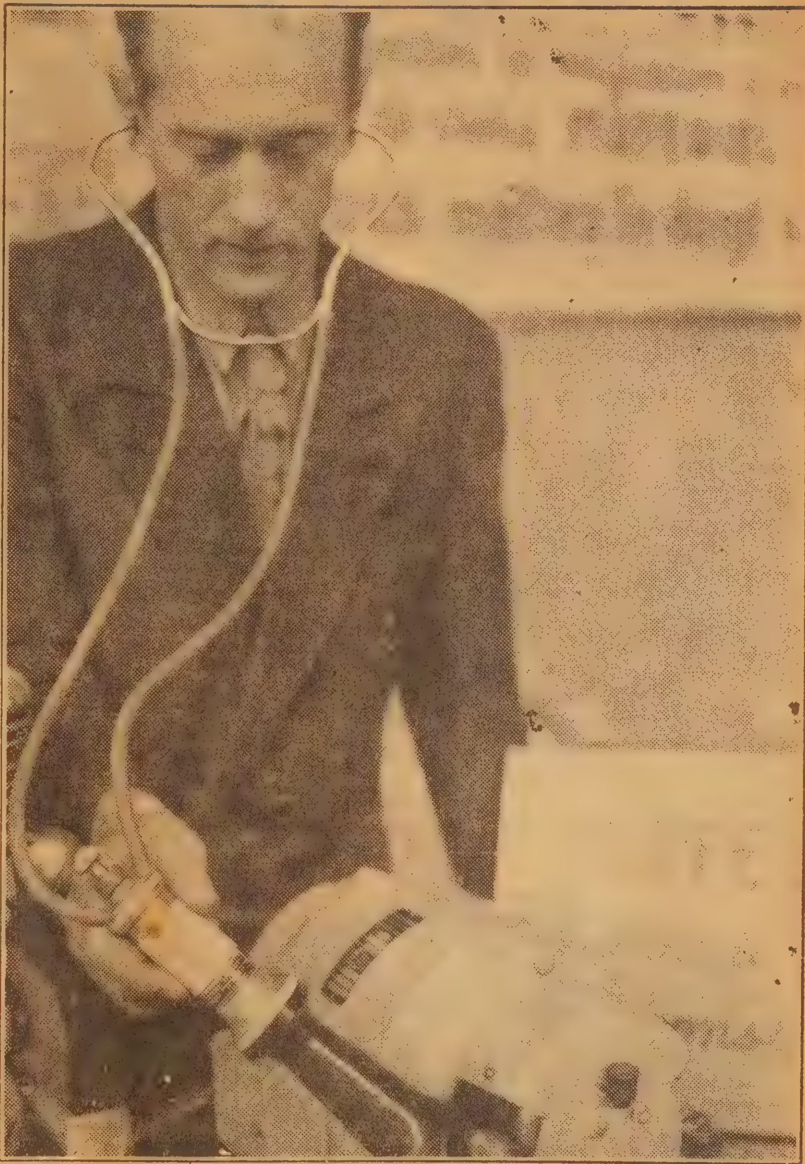
The water that leaves the head is carried again to the shore so that any object which has been caught in the rip may travel with it. This is, however, not always the case, as many of those who have been caught in a rip have discovered.

A lot depends on how far one is carried out to sea. It is advisable for swimmers to try and keep inside the breaker belt if caught in a rip. Then by swimming parallel to the shore it is most likely they will touch bottom after a short swim. If one is carried outside the breaker belt it is a long swim home. It is also sometimes difficult to swim out of one side of a rip, but very easy to swim out of the opposite side, although one has not much time to experiment!

A rip is very irregular in its behavior, and it is sometimes worth while treading water inside the breaker belt when most likely the conditions will suddenly change for the better.

It is hoped that this little discussion on various aspects of wave conditions will make your visits to the sea shore more interesting and perhaps assist if and when difficulties arise in the water.

NEW INDUSTRIAL STETHOSCOPE



A French firm exhibited this "industrial stethoscope" at the recent European Fair, held at Strasbourg. The directional pickup horn allows sources of noise to be localised and studied more effectively than with a conventional stethoscope.

Seen any saucers?

THE Civil Aviation Department and the Australian Flying Saucer Investigation Committee want people to report "unidentified objects" in the sky.

Representatives of both organisations have urged people who saw strange objects to report them.

But they discounted theories that the "objects" came from another planet.

Commenting on a recent sighting, the Melbourne superintendent of Air Traffic Control (Mr. R. M. Seymour) said: "People who see unidentified objects in the sky should not be frightened to tell us for fear of being ridiculed.

"When they report we can check to see if any plane positions fit the time and place the object was seen."

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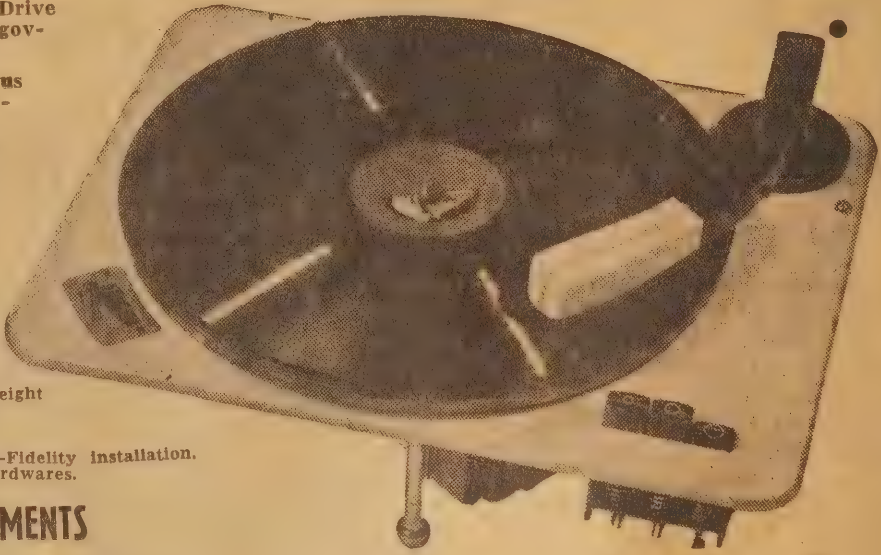

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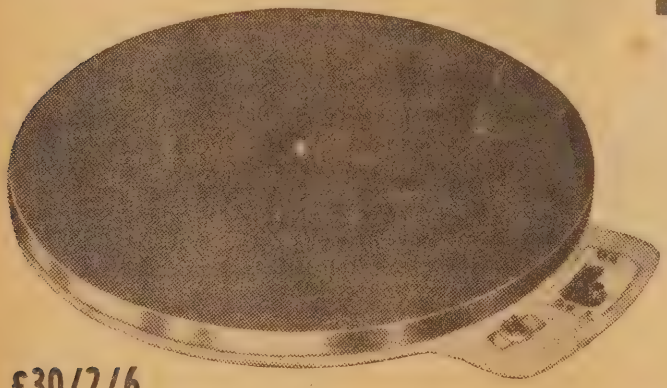

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Technical Review

NEW TETRODE AMPLIFIER HAS DUAL FEEDBACK SYSTEM

Here is a circuit that should be of special interest to constructors of the Williamson Amplifier or variations therefrom. It uses tetrodes with multiple feedback loops to obtain very low distortion, increased power output and higher plate efficiency.

IMPROVING the power output and stability of the Williamson amplifier circuit without increasing distortion and plate-power consumption involves special design considerations.

Obtaining 15 to 20 watts output without using four output tubes and a large power supply, and without operating the power tubes beyond ratings, rules out a triode output stage.

A tetrode output stage, besides requiring considerably more feedback to equal the distortion performance of a triode stage, raises a stability problem that has not been discussed before. The voltage gain of a tetrode output stage is proportional to its load impedance, and this load impedance is highly variable with frequency in the case of a speaker load.

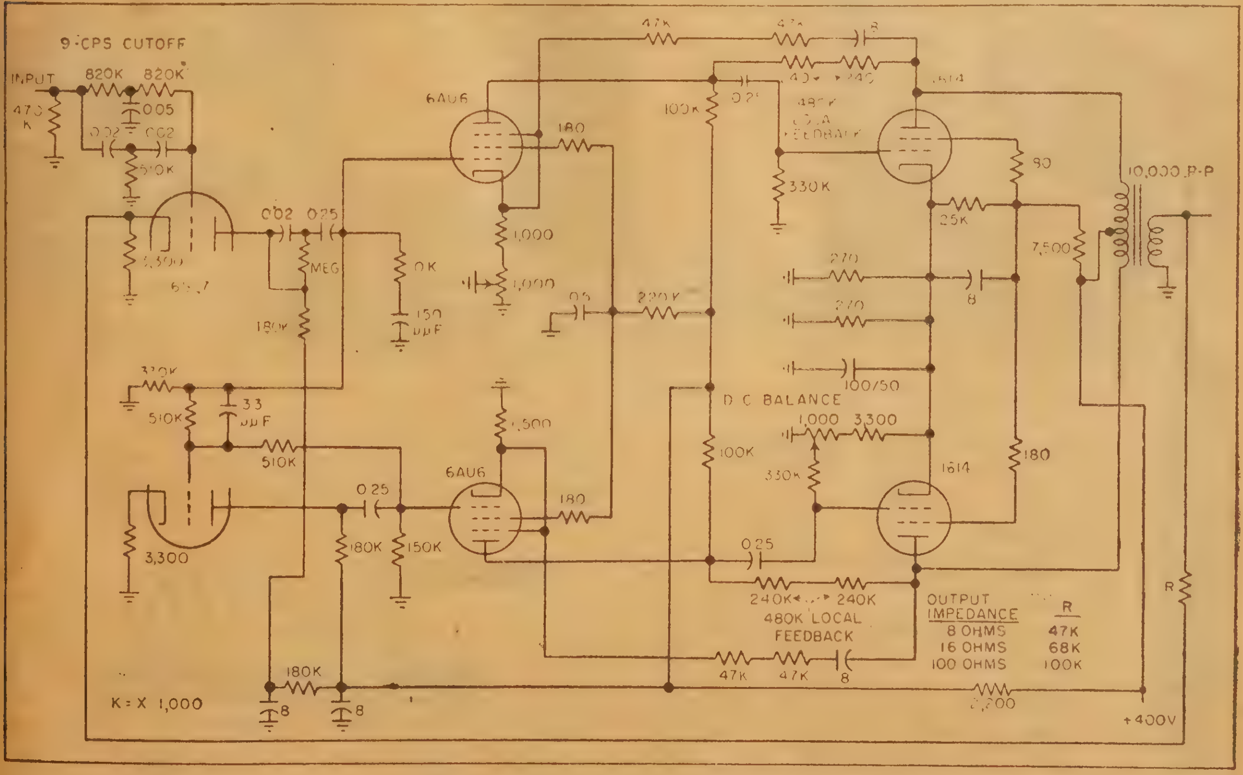
Since the voltage gain of the output stage is part of the gain of the overall feedback loop (whether taken from the primary or secondary of the output transformer), stabilisation of the feedback loop is made more difficult.

It is therefore necessary to obtain a low output impedance in the output stage itself, before overall feedback is applied, to make the gain of this stage relatively independent of loading.

This may be done in only three ways—by using triodes, with their numerous disadvantages; by loading the stage with resistance in addition to the speaker, and thus wasting a good part of the increased power output obtained from tetrodes; and, finally, by using local feedback in the amplifier output stage.

SPECIAL CASE

An example of 100 pc local feedback is found in the cathode-follower output stage. An extremely low output impedance is realised in this way, but the driving requirements are severe, and high plate-supply voltages are required in the drivers. A more practical device is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180K
150K
180K
8
8
K = X 1,000
6AU6
180
1,000
1,000
0.5
220K
6AU6
1,500
180
47K
47K
8
240
240
1614
100K
0.25
480K LOCAL FEEDBACK
330K
90
25K
10,000 P-P
7,500
270
270
8
100/50
D C BALANCE
1,000
3,300
100K
330K
1614
180
0.25
240K
240K
480K LOCAL FEEDBACK
47K
47K
8
2,200
+400V
R

OUTPUT IMPEDANCE	R
8 OHMS	47K
16 OHMS	68K
100 OHMS	100K

Circuit of complete amplifier. Value of feedback resistor R depends on impedance of speaker used. Output tubes can be 1614, 6L6, 5881, KT66 or presumably 807's.

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Local feedback may also be obtained by driving the screens with a fraction of output voltage, but, since the relationship between control grid and screen grid is not linear, it is preferable to feedback to the control grids.

In this case, the 480,000-ohm local-feedback resistors, together with the 100,000-ohm 6AU6 plate loads, provide about 12 db of local feedback, and make the output impedance of the power stage in itself about 1200 ohms at each plate. This figure compares favorably with the 1700-ohm plate resistance of the 6L6 as a triode.

MORE OUTPUT

This driver and power stage combination is similar to the triode equivalent in both output impedance and distortion, but power output is doubled and the B plus requirement is somewhat reduced. It only remains to add a phase inverter, a gain stage and the overall feedback.

The phase inverter used is of the paraphase or anode follower type, and is difficult to surpass. For high frequency applications this circuit has given excellent balance to 1 mc.

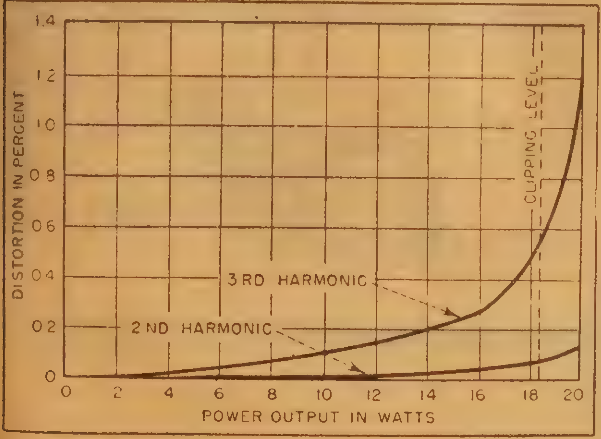
The other half of the 6SL7 functions as a voltage amplifier. Overall feedback, as seen from Fig. 1, is split into push-pull feedback from the output-transformer primary, and a single-ended feedback loop from the secondary which encloses the first loop.

TOTAL FEEDBACK

Each of these loops contributes about 12 db, making the total feedback around the output stage 36 db, including local feedback. This procedure avoids using a very large amount of push-pull feedback, requiring critical control of balance, and also avoids using 20 db or more of feedback from the secondary with the questionable stability that often results.

With the present design, including the 10,000-ohm—150 and 1 meg—0.02 phase-control networks, complete stability is obtained on open circuit, speaker load, or with any degree of capacitive loading. There is no tendency toward oscillation under conditions of heavy overload and recovery from such overload is immediate.

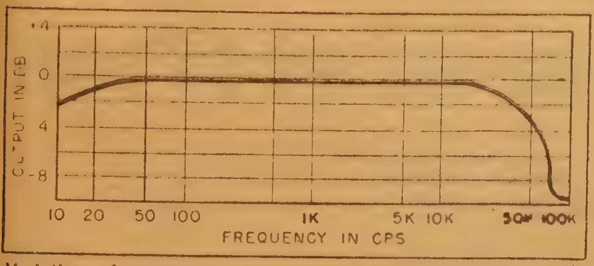
The resultant freedom from instability under all dynamic conditions is of far greater practical interest than a perfectly flat frequency response beyond the audible range.—(Electronics, by Joseph M. Diamond, Development Engineer, United Transformer Co., New York.)



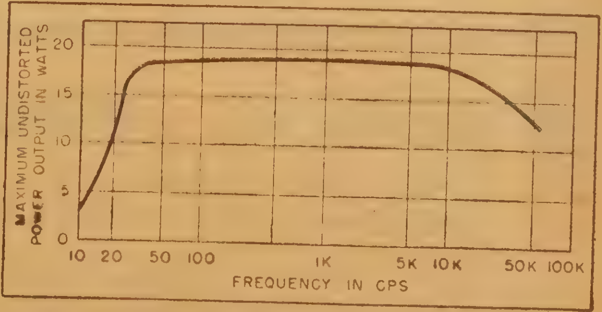
☆

Distortion compared to power output at 1,000 cps Curve is substantially the same at 50 cps.

☆

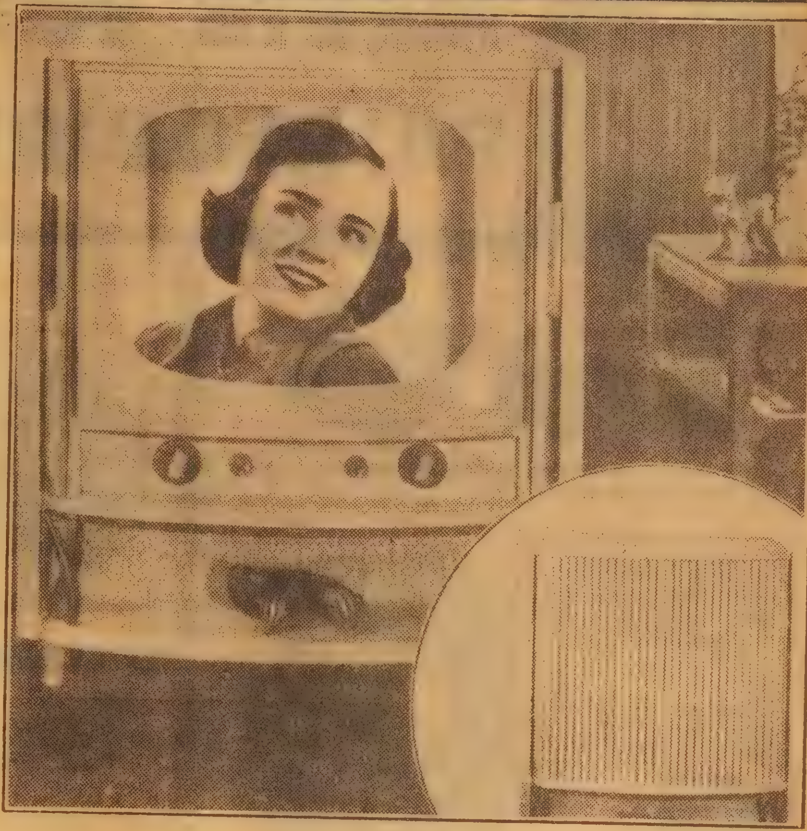


Variation of response with frequency at 1-watt output with 8-ohm load.



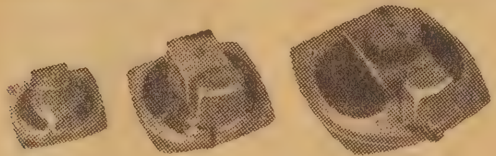
Maximum undistorted power output over frequency range of amplifier.

WOULD YOU LIKE THIS TV SET?

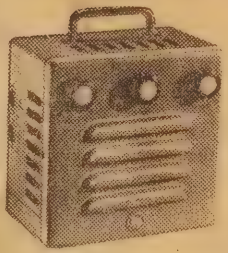


Typical of the TV receivers currently being sold in the U.S. is this Stromberg-Carlson "Empire" console. Measuring 40½ x 31½ x 21 ins. overall, the cabinet finish is described as "comb-grain, limed oak veneer with tambour design sliding doors". Inset shows doors closed. The set uses a 24-in. aluminised kinescope and 12-in speaker.

MEETS YOUR P.A. REQUIREMENTS



A.W.A. permanent magnet speakers are available in a range of sizes and types for every P.A. and sound reproduction need.

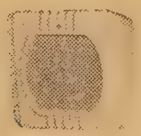


Amplifiers from five watts to seventy watts, for mains or accumulator operation, provide wide audio range reproduction, robust construction and reliable operation. Each model is built to the same high standards of quality workmanship and performance for which A.W.A. has established a world wide reputation in broadcasting and communication equipment.

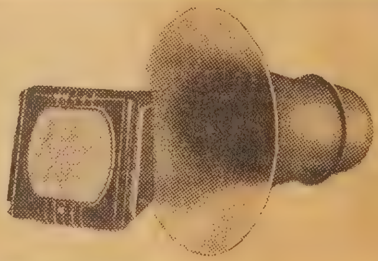
Portable address system model PA90 operates from mains or accumulator.

Pillowspeaker PS50 is a crystal type speaker for hospital or home use.

The A.W.A. Twin Jewel Transcription Pickup, designed to meet the exacting requirements of modern broadcast installation is the ultimate for audio system high fidelity reproduction of modern wide range recordings.



Attractive ivory and walnut housings for wall or table mounting, and flare housings for high efficiency and outdoor requirements are available to suit the various speaker sizes.



A.W.A. Sound Engineers will be pleased to survey your requirements and submit estimates for permanent installations. The Public Address Hiring section is equipped and staffed to meet any temporary need for sound amplification.

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MOVABLE ANODE TUBE CHECKS SURFACE ROUGHNESS

A pickup stylus, coupled to the movable plate of a transducer tube measures roughness on a wide range of surface shapes. The high electrical output of tube reduces the complexity of associated amplifying and indicating circuits.

MEASUREMENT of roughness requires a means of comparing minute surface deviations with the nominal surface of the material.

In the unit to be described, a pickup head incorporating a movable-anode tube and a diamond stylus is used to measure the deviations. The movable-anode tube feeds a highly stable vacuum - tube voltmeter through a two-stage triode amplifier.

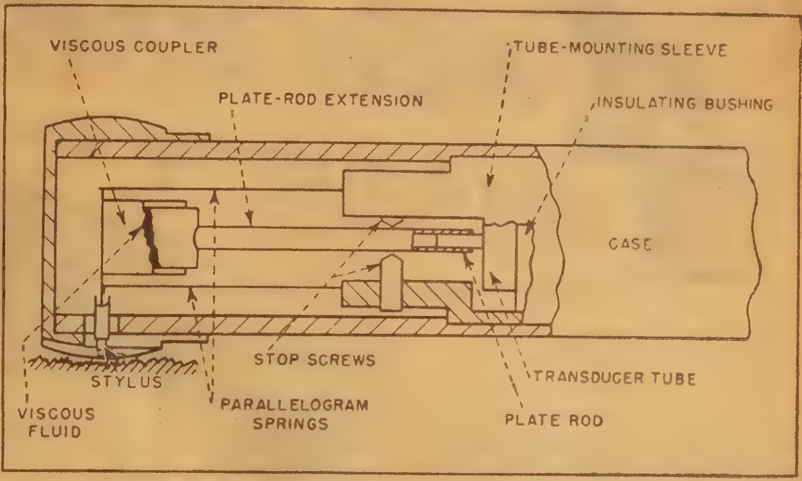
As a means of sensing the irregularities, a diamond stylus with a 0.0005-inch tip radius is used.

The reference surface from which stylus deflections are measured is established by two large-radius skids. These skids ride over fine scratches following the nominal surface contour.

Mechanical displacement is converted into electrical signal by an RCA 5734 electro-mechanical transducer. This device is a three element, all-metal vacuum tube constructed as shown in Fig. 1.

The plate rod can be moved with respect to other tube elements by an extension through a thin metal diaphragm that seals one end of the tube. This relative motion changes the tube characteristics so that variation of output voltage can be used to indicate mechanical displacements.

Several features make this transducer useful for measuring surface roughness and other small displacements. It has a high ratio of electrical output to mechanical input.



Cross-section of pickup head showing suspension of parts.

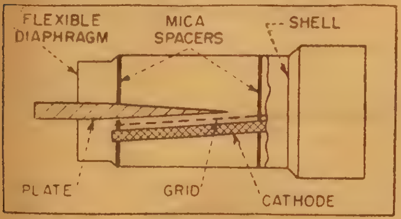


Fig. 1—Type 5734 tube used as transducer.

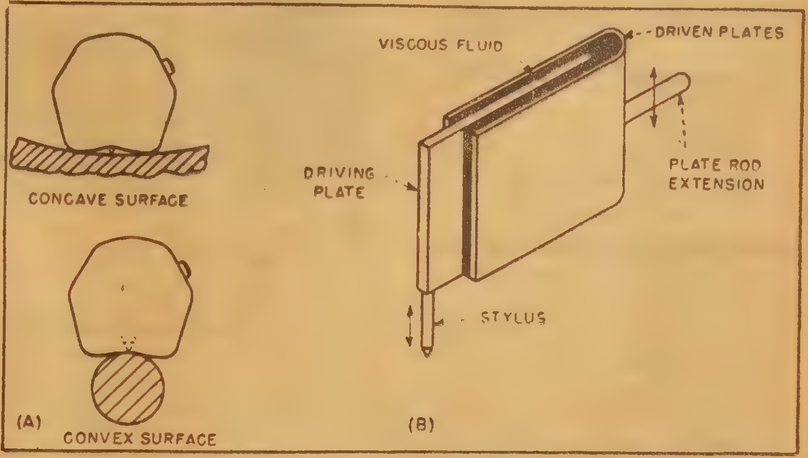


Fig. 3.—Range of surface contours (A) requires variable stylus position. Viscous coupling (B) permits this variation while limiting travel of plate rod.

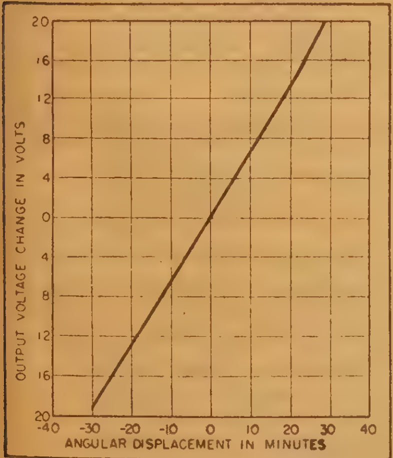


Fig. 2—Variation in movable anode tube output voltage with displacement of anode.

The size and weight of the tube are small and the force required to deflect the plate rod from its neutral position is moderate. The principal drawback is the limited allowable movement of the plate rod.

Movement of more than ½ deg. either side of neutral may result in permanent deformation of the diaphragm, or in damage to tube elements. This angular restriction amounts to plus or minus 0.008-inch movement on the end of a 1-inch extension to the plate rod.

To permit use of the pickup on a wide variety of surface shapes a total allowable stylus travel of about 0.040 inch is provided. The need for this range of travel can be seen from Fig. 3A, which shows the relative positions of the stylus and skid on different surfaces.

Although the nominal extension of the stylus from the housing varies considerably, the motion required after engagement with the surface ranges from only a few micro inches to 0.001 inch.

The use of a long extension of the plate rod to provide for sufficient travel, is undesirable, since the sensitivity would be reduced.

A viscous coupling was developed to limit anode movement without restricting position of the stylus. The construction of this device is shown. A plate attached to the stylus is suspended within a U-shaped driven plate. Space between plates is filled with a viscous fluid.

Displacement of the driving plate transmits force through the viscous material to the driven plate. The spacing of the plates is such that the fluid is kept in the clearance space by capillary attraction eliminating the need for seals.

Traversing the pickup over the surface, the high-frequency displacements of the stylus are transmitted undiminished through the coupling to the transducer tube.—(Electronics, November, 1953.)

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NEWS AND VIEWS OF THE MONTH

Antarctic Expedition

HUNDREDS of friends, relatives, and sightseers recently farewelled the Australian Antarctic expedition from Melbourne in the ship, Kista Dan.

The ten members of the expedition will stay in the Antarctic for more than a year.

Their leader, Mr. P. G. Law, who is Director of the Antarctic Division of the Department of External Affairs, will return to Australia in about three months.

With him will be four RAAF men, including two pilots, who will make aerial surveys until weather conditions make flying impossible. Main aims of the expedition are to:

Consolidate Australia's claim to a large section of the Antarctic by planting an Australian flag on the frozen mainland.

Survey the hinterland for mineral wealth.

Establish a permanent Australian weather base farther south than ever before.

Improve accuracy of Australian weather forecasting.

Determine, by nutrition and exhaustion tests, man's reactions to living in the frozen southland.

Tiny radio

A WRIST radio has been developed at the Signal Corps Engineering Laboratories at Fort Monmouth, N.J., that uses three transistors instead of ordinary vacuum tubes and picks up New York City radio broadcasts 40 miles away.

Powered by a mercury battery a little larger than the tip of a pencil, the radio has a short antenna worn up the user's sleeve, comic-strip style. Sound is carried to the soldier's ear through wires that connect to a hearing-aid earpiece.

Although the tiny radio does not transmit, it can receive programs on a tuning range of 1000 to 1500 kilocycles. This is about half of the standard broadcast band.

Built to explore the possibilities of shrinking bulky Signal Corps equipment, the radio is housed in a transparent plastic case two inches long, one and one-eighth inches wide and three-fourths of an inch thick.

Fuel mileage indicator

A FUEL mileage indicator that may be the delight of economy-minded motorists and government officials has been invented by William J. Sturtz, of Los Angeles.

Resembling a speedometer, the device registers the number of miles achieved to a given gallon of gasoline, the total number of gallons consumed on a certain trip, and the number of gallons used each hour.

The idea, according to Mr. Sturtz, is to provide the motorist with means of figuring out the fuel consumption either per mile or per hour, and to help him check the economy of fuel consumption at various speeds and with various gasolines.

The device is driven partly by a cable that connects into the speedometer-drive mechanism and partly by a cable that is powered by a fuel meter installed between the fuel pump and carburettor of the vehicle.

The device registers the number of miles as they are clicked off on a gallon of gasoline. Just before the gallon is expended, a bell sounds to attract the motorist's attention. Then the miles-per-gallon indicator resets to zero and begins recording the miles obtained on the next gallon of gas.

U.S. "Minisub"

THE US Navy plans to lay the keel for the first of its new midget submarines within two months.

The "Minisub" is designed to launch and steer guided missiles and to plant atomic mines in enemy harbors.

George F. Chapline, general manager of the engine division of the Fairchild Airplane Corporation, which has the navy contracts to build the first of the minisubs, said the midget will have aeroplane-like controls.

One man will be able to operate the minisub on the surface or under water.

The other two members of the three-man crew will carry out special assignments.

Mr. Chapline said the minisub will be "about 50ft long, as sleek as a jet aeroplane and driven under the surface by a unique power plant."

From previous announcements concerning the development of a midget submarine, it is believed that the minisub will be light enough to be carried overland by huge helicopter-type "flying cranes".

Artificial hands move

KOREAN war veterans who lost hands in service, are being fitted with artificial hands that can be moved by the muscles of the man's stump.

Civilians who lose hands in industrial or traffic accidents can have the same kind of hand, Dr. Ernst W. Bergmann, of New York, pointed out at the meeting in New York of the US and Canadian Chapters of the International College of Surgeons.

The method can also be used for arm stumps, he said.

POPULAR SCIENCE QUIZ

Q. How are ships rated in terms of "size"?

A. Ship size is expressed in terms of gross, net, deadweight and displacement tonnage. Gross tonnage refers to the total enclosed cubic capacity of the ship with 100 cubic feet being equal to one ton. Net tonnage is the cubic capacity available for cargo. This is expressed also in terms of 100 cubic feet per ton. Deadweight tonnage is the total long ton weight of fuel, water, stores and cargo that a ship can carry. Displacement tonnage is the weight of water displaced by the vessel.

Passenger ships are commonly rated by gross tonnage, cargo ships by net tonnage, warships by displacement and tankers by deadweight.

Deadweight carrying capacity is the difference between the weight of water displaced when fully laden and that displaced when light. A tanker operator makes an allowance for the fuel, water and stores necessary for a specific voyage in calculating the cargo-ton carrying capacity of the vessel for that particular voyage.

Q. Besides fuel selection, what other means are there of reducing engine-knock?

A. Of recent news from USA is a new process designed to improve fuel and engine performance with petrol engines. Invented by Dr. Sophia Berkman, an authority on catalysts, the process involves casting into the cylinder head or piston a series of small plugs of a synthetically-compounded catalyst.

This catalyst lessens the need for higher octane petrol by assisting in a more complete combustion. It also tends to prevent carbon formation and the destructive effects of "knock" or "ping".

The catalyst is composed of a mixture of minerals and appears to be self-regenerating. It should last as long as the engine.

Q. What is the maximum altitude at which birds have been known to fly?

A. To date, the record is held by a flock of geese which were photographed while flying at 29,000 feet near Dehra Dun, India.

The conquerors of Mount Everest, Sir Edmund Hillary and Tensing Norkay, saw an unidentified bird flying at a height of more than 27,000 feet. The leader of that successful expedition, Sir John Hunt, reported seeing two birds near their camp at 26,000 feet. During the 1921 assault on Mount Everest, Dr. A. F. R. Wollaston reported seeing a giant vulture, the lammergeier, at 24,000 to 25,000 feet.

Other altitude records are:—godwits and curlews 20,000 feet, Andean condor more than 19,000 feet, black-bellied plovers, yellow-legs and sand pipers 10,000 to 12,000 feet, cranes, pelicans and ducks 3000 to 8000 feet.

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PUBLIC ADDRESS RANGE
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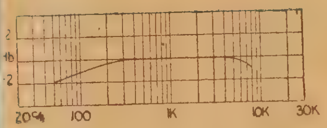
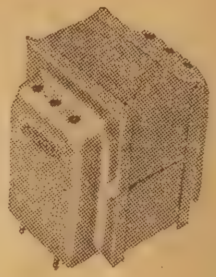
This range is designed for use with public address systems, factory music while you work, etc. A small section of our extensive range is presented below.

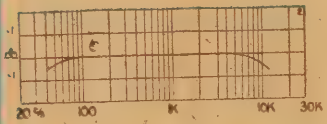


Code No.	Watts	PRIM Z.	SEC. Z.
OP-1	10	5000, 2500 SE	12.5, 8, 2.3
OP-1A	10	5000, 2500 SE	500
OP-2	15	5000 PP	12.5, 8, 2.3
OP-3	15	6600 PP	12.5, 8, 2.3
OP-4	15	10000 PP	12.5, 8, 2.3
OP-11	25	6600 PP	500, 250, 125
OP-12	25	10000 PP	500, 250, 125
OP-15	32	6600 PP	500, 250, 125
OP-16	32	10000 PP	500, 250, 125
OP-37	80	6400 PP	500, 250, 125

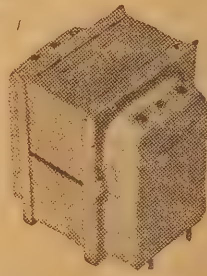


MEDIUM FIDELITY RANGE
40-12000 C/S ± 1 dB

This range has been especially designed for use with the Rola 12-OX speaker. These transformers are especially suitable for use with triodes.

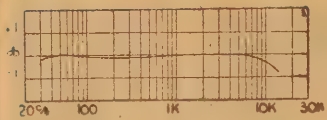


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-112	6	10000 PP	2
OP-113	6	5000 SE	2
OP-117	6	5000 PP	2
OP-118	6	8000 PP	2
OP-119	6	6600 PP	2
OP-183	6	7000 SE	15, 2

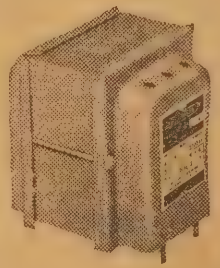


HIGH FIDELITY RANGE
30-15000 C/S ± 1 dB

These transformers are primarily for use with Goodman and other extended frequency response speakers. Section below is only small part of our range.

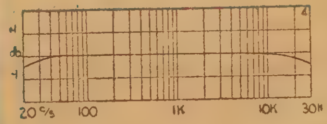


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-22	10	3250 SE	500, 25, 2.3
OP-23	10	3250 SE	12.5, 8, 4, 2.1
OP-19A	15	5000 PP	12.5 8. 2.3
OP-19B	15	5000 PP	500, 250, 125
OP-21	15	8000 PP	500, 250, 125
OP-62	15	10000 PP	500, 125
OP-63	15	10000 PP	15, 3.75
OP-64	15	10000 PP	12.5, 3.125
OP-65	15	10000 PP	8.4, 2.1
OP-51	20	4500 PP	15.5, 12.5, 8.6, 2.8, 2

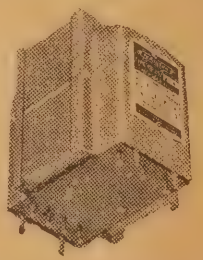


SPECIAL HI-FI RANGE
20-30000 C/S ± 0.5 dB

These transformers are for use in the Williamson Amplifier, and fulfil every requirement specified by D. N. T. Williamson.



Code No.	Watts	PRIM. Z.	SEC. Z
OP25/500	15	10000 PP	500, 125
OP25/250	15	10000 PP	250, 62.5
OP25/40	15	10000 PP	40, 10
OP25/16	15	10000 PP	16, 4
OP25/15	15	10000 PP	15, 3.75
OP25/12	15	10000 PP	12, 3
OP25/10	15	10000 PP	10, 2.5
OP25/8.4	15	10000 PP	8.4, 2.1
OP-66	15	5000 PP	8.4, 3.7
OP-67	15	5000 PP	15, 6.5



Ferguson Transformers Pty. Ltd., Ferguson Lane Chatswood— Phone JA2878. Available from retailers in every State.

Lunar bridge

DISCOVERY of a 20-mile bridge across a mountain barrier on the moon was described recently by Percy Wilkins, director of the Lunar Group of the British Astronomical Association.

Through his telescope he said it looked like "an artificial job", though it was not artificial.

It was 5000ft above plain level, with an arch probably two miles long.

"It is absolutely regular in outline," said Wilkins.

"It casts a shadow when the sun is low on the moon's horizon and you can see sunlight streaming in beneath it.

It is the most extraordinary feature now known of the moon."

Wilkins said a possible explanation of the bridge was that a meteorite had crashed through a molten lava barrier.

As the barrier solidified, the arch was left.

The bridge was first observed by the late John O'Neill, New York Herald-Tribune science editor, five weeks before his death last August.

He wrote to Wilkins who confirmed its existence.

84,000,000 Phones

THE World now has 84-million telephones—double the total before the war.

The US, with 6 pc of the earth's population, has about 60 pc of the phones, the American Telephone and Telegraph Company reports.

There are 48-million phones in the US.

Next is Britain with nearly 6-million.

Canada is third with nearly 3½-million, and West Germany fourth, with just under 3-million.

Canadians are the greatest phone users, the company reports.

Telephone conversations averaged 388.7 per person a year, while in the US, the figure is 382.1.

The British limit themselves to 68.7, while the Turks were the most close-mouthed of all with 5.3 calls per Turk.

Delay in TV

AUSTRALIA should not delay the introduction of television, according to Mr. Emlyn Jones.

Mr. Jones, a scientist, is a Fellow of the British Television Society.

He has been in charge of TV research at the Mullard Research Laboratory (Surrey) for six years.

Mr. Jones will be superintending scientist at the long-range weapons establishment at Salisbury, South Australia.

He said: "Australia seems awfully anxious to introduce the right system of television.

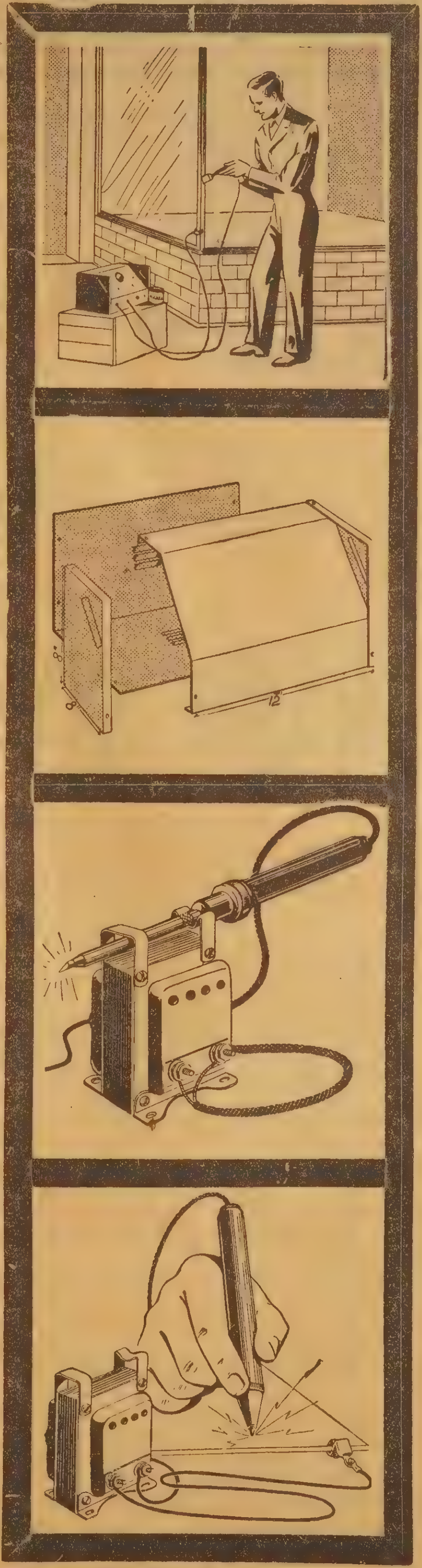
"But I think you can hesitate too long.

"It is wrong to delay TV on the grounds that superior TV sets will be developed.

"Most of the improvement comes from studio technique, and not in the sets.

"Pictures on a TV screen today are only a little improved on what we were seeing in 1936.

"TV technique aided the development of radar during the war, and can still be an important factor in wartime radio scientific advancement.



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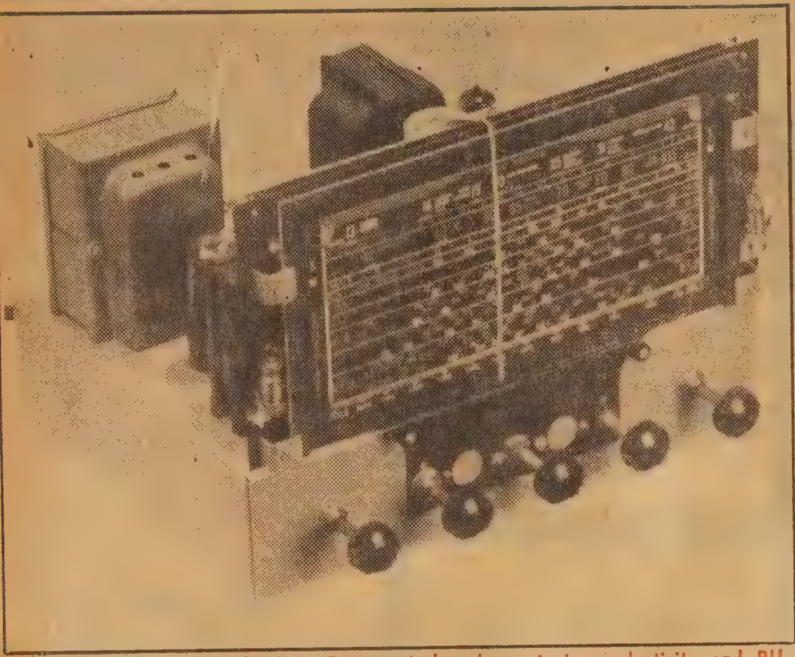


The controls are, from the left: Bass control, volume, tuning, selectivity and PU switch, treble control. The power supply components are visible at the left-hand end. The dial glass shown in this photograph also carries short-wave markings. The correct glass for this set would be one carrying only broadcast station markings.

THE WIDE-BAND SIX FOR 1954

Here is our latest radiogram employing 6 valves in all. A fitting successor to the "Wide-Band Six" of 1952, this new design features wide-band tuning, variable selectivity and a continuously variable tone-control system giving boost and cut for both bass and treble.

by Raymond Howe

IT was back in November, 1952, that we presented the first "Wide-Band Six", a set which proved very popular indeed. It was, in fact, the first combination of our wide-band superhet tuner with an audio system on the one chassis.

In common with the earlier tuners using the same wide-band principle, the results obtained in most areas were very good, particularly where the speaker system was capable of extended range up to around 10 Kc. The combination of a bandpass aerial circuit and a 1900 Kc IF channel passed just about all the frequencies there were to be heard.

INTERFERENCE PROBLEM

However, in some locations, as the evening hours approached, distant regional and New Zealand stations did sometimes introduce annoying "splatter" into the local channels, a condition peculiar to any form of wide-band tuning. The trouble was evident mostly in those areas where local station strength was insufficient to retard automatically the gain of the tuner.

The obvious answer to this problem was some sort of control over the selectivity so that adjacent-channel interference could be attenuated when desired, while still retaining the wide-band facility wherever it could be used.

Even before description of the 1952 wide-band superhet principle, we had published circuits employing a limited scheme of variable selectivity in the IF channel. Since then we have spent some time on applying this idea to the wide-band superhet, and with considerable success.

Among other things, it meant abandonment of the 1900 Kc channel.

The procedure we adopted involves permanent loading resistors on the first IF transformer of a 455 Kc IF channel and switched coupling between the anode of the IF amplifier and the detector diode.

In the "wide-band" position of the switch, resistance-capacitance coupling is used, allowing the full passband of the special aerial circuit to be realised.

In the "normal" position, a standard 455 Kc IF transformer is brought into circuit to raise the selectivity very close to that of a standard superhet. As we have said before, it gives you virtually two tuners in one, for a few extra shillings.

This idea was incorporated in the "Wide-Band Seven" of November, 1953, and its facility has been appreciated by readers living in difficult areas troubled with sideband chatter.

A NEW SIX

Inevitably there has arisen a demand for a similar set using a single-ended output system—in other words, a new "Wide-Band Six".

This then is the story of our present set which we present as our latest six-valve radiogram featuring wide-band tuning, variable selectivity and a fully variable tone-control system.

The tone-control system is very similar to that used in the Unit Playmaster amplifier No. 6, described last month.

In this new set we have specified miniature valves in all positions except that of the rectifier. The first three valves, viz, 6AN7, 6N8, and the first half of the 12AT7, are used in a circuit which follows very closely that of the front end of the "Wide-Band Seven".

The main difference is in the method of feeding the 6AN7 screen and oscillator anode. This is taken from the decoupled point which feeds the 6N8 anode and screen. The available bass boost and consequent low frequency sensitivity of the audio system made it essential that all early stages handling audio be adequately decoupled from the HT line to avoid instability. For the same reason, the oscillator had to be fed from a stabilised point, as shown.

SUPPLY VOLTAGES

The decoupling resistors to the lower end of the 6N8 anode and screen resistors, and the voltage-dropping resistor for the 6AN7, have been selected in value to give, at minus 2-volt bias, a "no signal" condition of about 80 volts to the 6AN7 screen and oscillator anode, and about 175 volts at the 6N8 feed point.

The 6N8 screen dropping resistor has been arranged to provide a screen voltage of about 80 volts. When tuned to a station, the feed point to the 6N8 rises to around 200 volts.

In the bandpass aerial circuit, the 4.7 pf "top" coupling and the .02 mfd "bottom" coupling are relatively critical values and should not be varied other than on the recommendation of the coil manufacturer.

The .02 mfd capacitor also acts as the AVC bypass for the aerial circuit. For the "top" coupling capacitor we have successfully used in the past two lengths of 7/.010 thin plastic-covered hook-up twisted tightly together for a distance of about 2 inches, after allowing one end to splay just sufficiently to make contact between the appropriate pins on the coils.

Insufficient coupling here will not give the required passband, while too much coupling will produce a pronounced trough in the response with peaks of unequal amplitude on either side.

R/C NETWORK

In the wide-band position of switch S1, both windings of 1FT2 are short-circuited, leaving the 6N8 anode coupled to the detector diode anode through a resistance-capacitance network. The .05 megohm resistors across both windings of IFT1 broadens the response of the IF channel sufficiently to permit the full passband of the aerial circuit to be realised.

In the "normal" position of the switch both windings of IFT2 are brought into circuit and the IF channel selectivity approaches that of a standard superhet.

If when in the "normal" position, a heterodyne whistle is heard when tuning through some wanted local station, it may be of advantage to align the IF transformers to a new frequency displaced a few Kc to one side or the other of 455 Kc. This whistle will be encountered only when using a long outdoor aerial and in certain critical areas.

There is another form of whistle which can be heard with any wide-band set when used with a speaker system capable of substantial output around 10 Kc. This is due to the heterodyne between carriers of two stations operating on adjacent channels, which are normally 10 Kc apart.

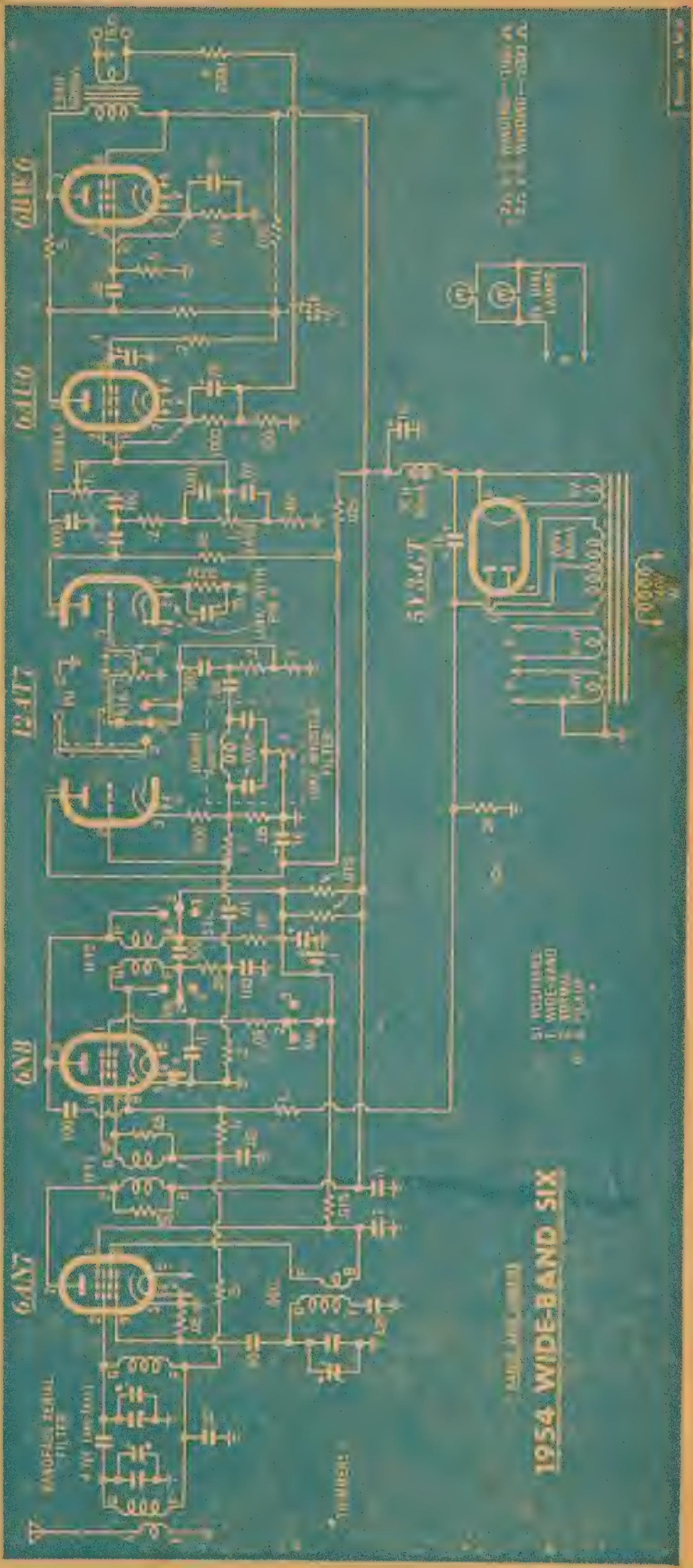
WHISTLE FILTER

To eliminate this possible interference, we have included in this set the same 10 Kc whistle filter circuit, as used in previous wide-band sets and tuners.

For satisfactory operation this filter must be fed from a relatively low impedance. This is provided from a cathode-follower circuit for which the first half of the 12AT7 is used.

Once the filter is adjusted, it introduces a sharply defined trough at 10 Kc, while having negligible effect elsewhere in the audio response.

The output from the cathode-follower stage is stepped down by a fixed divider to give a greater range of adjustment to the volume control. The .2 megohm resistor in this divider is shunted with a 500 pf



This circuit diagram may look somewhat pretentious but it does perform quite a number of functions. Optional decoupling of the 6AU6 stage is shown dotted. The direction of rotation for boost and cut of the bass and treble controls is discussed in the text. Note that standard 455 Kc IF transformers are used.

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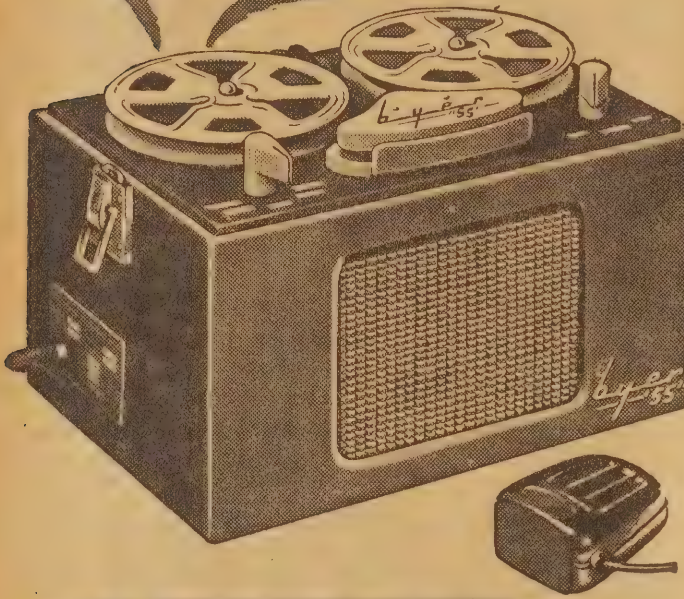

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capacitor to correct for some treble loss in the diode circuit.

The input to the main audio is selected by switch section S1d, positions 1 and 2 taking the output from the radio tuner and position 3 taking the output from a crystal pick-up.

In the design of the audio system, we did not budget for greater sensitivity than that required by a crystal pickup or a type having much the same output. Nearly all 3-speed record changers or players carry a pickup, these days, having an output of this order.

The second half of the 12AT7 is employed as the tone control stage. Briefly, the gain of the stage depends upon frequency and manipulation of the controls allows the associated capacitors to perform their functions.

The values of these capacitors have been selected to ensure independence of operation and for a reference frequency around 1000 cycles.

DECOUPLING CIRCUIT

Note that the anode resistors for both halves of the 12AT7 are tied together and decoupled from the HT line. We used a 16 mfd capacitor here so that the decoupling resistor could be kept fairly low to maintain the operating voltage for both sections at something over 200 volts.

The 6AU6 and the 6BW6 form the remainder of the audio system over which a considerable amount of negative feedback operates. The .5 megohm resistor at the 6BW6 anode gives a gain reduction of about 6 db on that stage alone. The second feedback loop takes in the output transformer by taking some output from its secondary winding and feeding it back into the cathode circuit of the 6AU6. The gain reduction due to this second loop is around 16 db.

Decoupling of the HT feed to the 6AU6 anode is shown dotted in the circuit diagram, as optional. Whether you fit these components depends upon the low frequency response of your speaker system and how critical you are in this respect. Make a test with the volume control turned off.

In the article on both the "Wide-Band Seven" and the original "Wide-Band Six" we discussed at length the factors influencing the choice of output transformer in terms of voice coil impedance. Rather than repeat the story once again, we would refer you to those articles.

The power supply will give an output voltage from the filter of about 275 volts for a current drain of around 70 mA. You would be well advised to use a 30 henry filter choke as, at full bass boost, the gain at low frequency is fairly high.

So much for the circuit design.

Unfortunately we could not retain the chassis of the original "Wide-Band Six". This was dictated by the physical layout for the tone control stage. It does, however, avoid the use of an extension shaft, coupling and mounting bracket for the switch.

The new chassis design measures 12in by 19½in by 2¾in. In the initial stages of designing the layout, a number of conflicting factors had to be dealt with. Judicious placement of the controls allowed all electrical requirements to be met but, to fit five controls on a chassis dimension of 12in, necessitated drilling two 3-8in diameter holes in the dial plate.

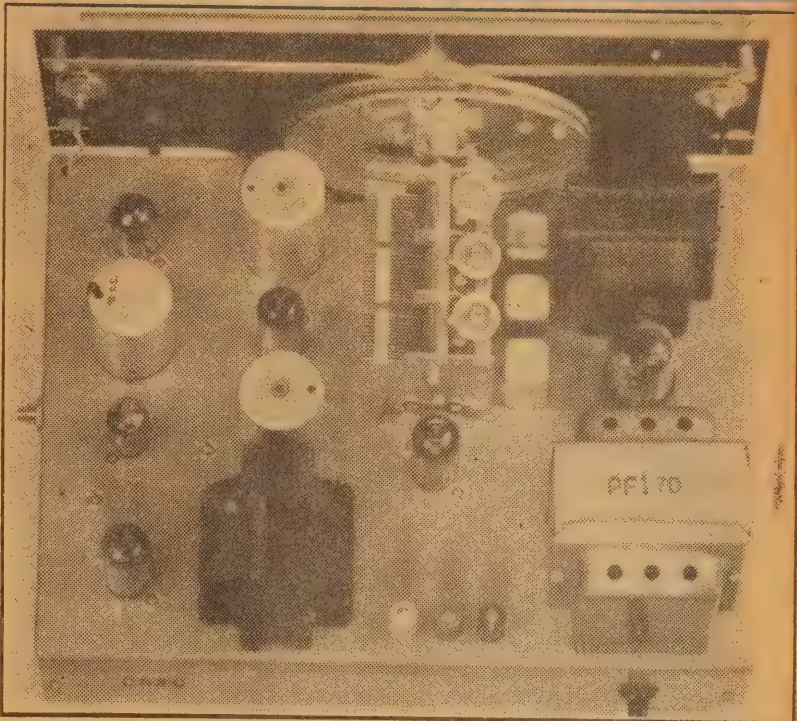
POSITION OF PARTS

These holes are located at the centre of the two slotted holes at 2 1-8 in from the centre hole carrying the tuning spindle bracket.

As with most sets, particularly those which carry a fair number of components, a logical orientation of valve sockets, coils and IF transformers leads to easier wiring and less chance of trouble from instability.

Viewing the underneath of the chassis as depicted in the under-

REAR VIEW OF THE RECEIVER



From bottom left towards the dial are the 6BW6, 6AU6, 10 Kc whistle filter inductor and 12AT7. In the same direction in the next row to the right are the output transformer, IFT1, 6N8 and IFT2. The 6AN7 is behind the tuning gang with the rear gang section tuning the oscillator. The power-supply components are at the right. The terminals at the rear are from left to right: PU earth, aerial.

PARTS LIST

1 chassis 12in x 9½in x 2¾in.
1 power transformer 285V a side 80mA, 6.3V 2A, 6.3V 2A, 5V 2A.
1 30H 75 or 80mA filter choke.
1 output transformer 5000 ohms with secondary winding to suit speaker.
1 3-section miniature gang tuning capacitor.
1 dial with glass to suit gang (USL46).
1 set bandpass aerial coils, broadcast band, (2 coils).
1 broadcast oscillator coil to suit 6AN7 (or similar) for 455 Kc IF.
2 standard 455 Kc IF transformers.
1 10 Kc whistle filter inductor (approx. 100 mH).
3 gang-section trimmer capacitors.
1 4-pole, 3-position switch.
4 9-pin, 1 7-pin and 1 octal valve sockets.

VALVES

1 6AN7, 1 6N8, 1 12AT7, 1 6AU6, 1 6BW6, 1 5Y3GT.

CAPACITORS

3 25 mfd 40PV electrolytics, 3 16 mfd 525PV electros., 1 8 mfd 525PV electro. 6 .1mfd, 3 .05mfd, 2 .02mfd, 1 .01mfd, 1 .005mfd tub., 2 .005mfd mica, 1 .001mfd, 1 500 pf, 1 425 pf mica (low tolerance) 4 100 pf, 1 50 pf, 1 4.7 pf ceramic. (All tubular capacitors 500WV).

RESISTORS

3 1 meg. ½w, 2 1 meg. potentiometers, 1 .5 meg. potentiometer, 1 .5 meg. 1w, 2 .5 meg. ½w, 1 2 meg. 1w, 3 .2 meg. ½w 1 .1 meg. potentiometer, 1 .1 meg. 1w, 1 .1 meg. ½w, 3 .05 meg. 1w, 4 .05 meg. ½w, 1 .025 meg. ½w 1 .02 meg. 1w, 1 02 meg. ½w, 3 .015 meg. 1w, 3 3000 ohms ½w, 1 1000 ohms ½w, 1 250 ohms 1w, 1 100 ohms ½w, 1 30 ohms ½w.

SUNDRIES

5 knobs, 3 terminals (1 black, 1 red, 1 other color) 2 6V dial lamps, 1 8-tag, 1 7-tag, 2 5-tag, 2 4-tag and 1 3-tag mounting strips, 2ft shielded hook-up wire, power flex and 3-pin plug, rubber grommets, tinned copper wire, hook-up wire, spaghetti insulation, solder, lugs, nuts, bolts, etc.

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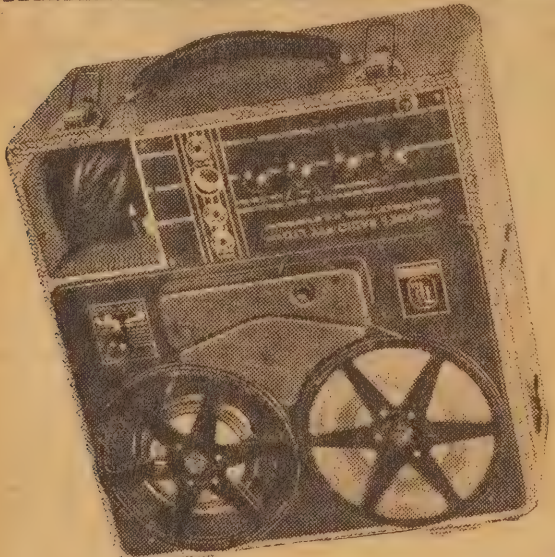

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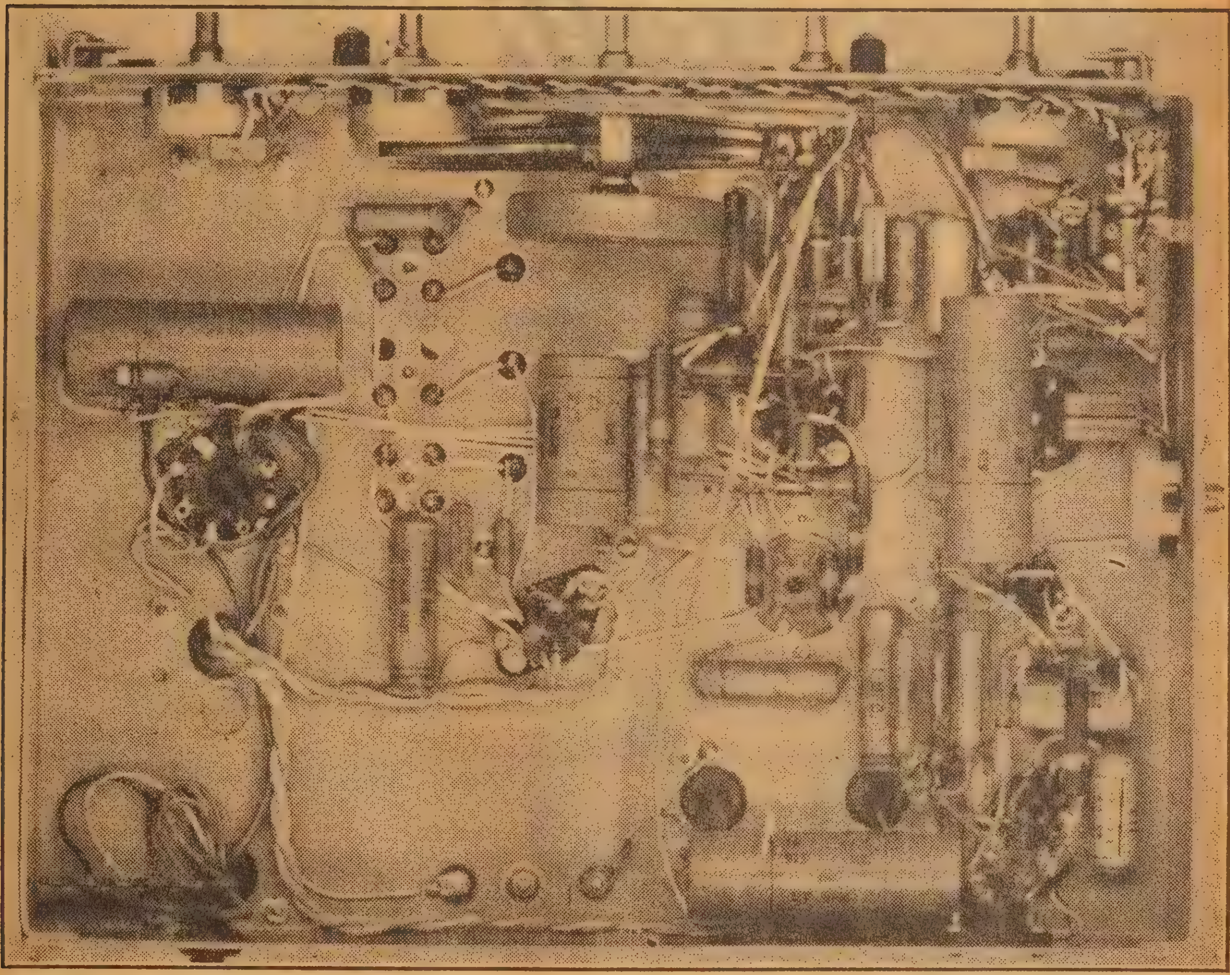

This underneath view gives the general trend of the grouping of the minor components. Liberal use of tag-mounting strips and logical orientation of the valve sockets, coils and IF transformers makes the task easier. The .1 megohm potentiometer associated with the whistle filter can be seen at the right mounted on the side of the chassis.

chassis photograph, this is the way in which we arranged these items.

For the valve sockets, the gap between pins 1 and 9 of the 6AN7 socket is toward the left rear corner, that of the 6N8 socket toward the right rear corner, that of the 12AT7 socket toward the 6N8, that of the 6BW6 socket toward the output socket. The gap between pins 1 and 7 of the 6AU6 socket is toward the switch. The keyway of the 5Y3GT socket is toward the dial flywheel.

COIL POSITIONS

For the coils, the underchassis photograph clearly shows the connection from the underside lug of the gang sections to the grid pin of each coil.

In the case of the IF transformers the grid pin of IFT1 is toward the 10 Kc whistle filter coil while the grid pin of IFT2 is toward the top right corner of the chassis.

We placed solder lugs at all miniature sockets at least under the bolt near the gap in the pins and joined these lugs together with a run of light gauge tinned copper wire. We suggest that you do this to avoid possible future trouble with faulty connections to the chassis. And by the way, don't forget to earth the centre of each miniature valve socket to the nearest solder lug.

We used tag mounting strips at strategic points to facilitate anchoring of minor components. A 5-tag size was used at the power flex input, a 4-tag on the 6N8 side of IFT1, a 5-tag on the 6N8 side of IFT2, a 7-tag on the chassis side near the 12AT7, an 8-tag alongside the 6AU6 and 6BW6 sockets and a 4-tag between these two sockets.

The locally-made miniature tubular capacitors and 25 mfd 40PV electrolytics were used where applicable. For convenience, ½watt size of resistors were used where possible but 1-watt size was used in positions carrying HT current. The parts list will be a guide here.

The positions of the various controls are given in the captions below the front view. The connections to the bass control are at relatively low impedance and the three leads are simply plaited together and run along the inside face of the chassis with one lead terminating on the treble control and two on the tag strip near the 12AT7 socket.

The .02 mfd and .001 mfd capacitors are mounted directly on the control. Note that the third wire is used to enable the .02 megohm resistor to return to chassis near the 12AT7 socket to avoid possible hum injection into this circuit from chassis eddy currents.

The volume control connections are made in thin shielded wire with the shield braid acting as the earth return back to the solder lug at the 12AT7 socket. Slip some spaghetti sleeving over each braid where it passes over the switch frame.

The shielded wire from the pick-up terminal passes direct to the appropriate lug on an upper section of the switch with the braid bonded to that of the wiring to the volume control. This ensures a single earthing point for all of this shielded wiring.

THE SWITCH

In wiring the switch, make a preliminary strudy of the lugs to its sections. We used the two lower sections for the IF transformer switching and the two upper sections for the volume control and 6N8 screen switching.

Make the switch connections to the IFT2 as short and direct as possible. We used tinned copper wire and insulated it with spaghetti sleeving.

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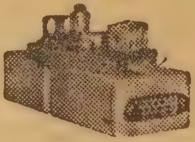

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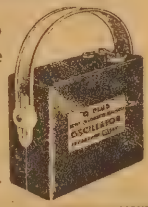

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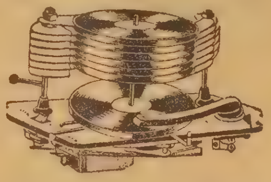

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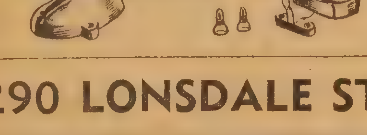

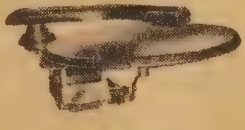

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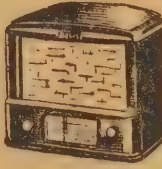

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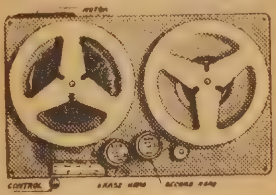

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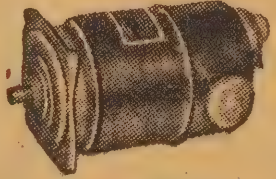

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YOUR WIDE-BAND COIL KIT

We have noticed that some of our readers have been supplied with an incorrect combination of wide-band coils and IF transformers. To clarify the situation, we are summarising the position here.

The orginal wide-band tuners of the August, September and December, 1952 issues and the Wide-Band Six of the October, 1952, issue employed a 1900 Kc IF channel. Thus the kit for any of these would comprise two aerial bandpass coils, the appropriate oscillator coil and padder capacitor and a pair of 1900 Kc IF transformers.

All wide-band tuners and sets since then, viz., July and November, 1953, issues, employed variable selectivity in a 455 Kc channel. A wide-band kit for these would consist of standard aerial and oscillator coil, padder, standard 455 Kc IF transformers plus a bandpass aerial coil as a single item.

A similar form of variable selectivity in a 1900 Kc IF channel is not feasible due to the already adequate passband for wide-band reception.

The 10 Kc whistle filter inductor may be used with either kit.

The connections to the treble control are straightforward with one end of each capacitor terminating directly on the control.

Conventional arrangement for bass boosting is with control turned full left and for treble boost with control full right. To achieve this, wire the .001 mfd capacitor on the bass control so that it is shorted out in the control boost position mentioned above.

For the treble control wire the 100 pf capacitor so that the moving arm of the control makes connection with it in the boost position.

The location of the whistle filter inductor deserves some comment. Due to existence of bass boosting in the audio system, hum induction into the whistle filter ceases to be a negligible factor. It now becomes necessary to orientate the inductor for minimum hum pick-up and it may well be that best results are obtained with the inductor at some odd angle.

During the wiring of this set, we left a vacant space surrounding the present position of the inductor to permit some unusual mounting of this component under the chassis if this was found necessary.

BEST POSITION

It turned out that the position for minimum hum pick-up was some 5 to 10 degrees from the vertical in the position it now occupies.

However, we were willing to trade a small amount of hum induction for the convenience of mounting the can in a conventional manner.

You can easily check for hum induction here with the can mounted in this position by making and breaking a shorting wire across the inductor pins with the aerial disconnected, the volume turned up and the bass boost operating. Make the assessment in the light of the position around which the volume control would normally be used.

Color Code

VALUE	BODY	END	DOT
1 meg.	brown	black	green
.5 meg.	green	black	yellow
.2 meg.	red	black	yellow
.1 meg.	brown	black	yellow
.05 meg.	green	black	orange
.025 meg.	red	green	orange
.02 meg.	red	black	orange
.015 meg.	brown	green	orange
3000 ohms	orange	black	red
1000 ohms	brown	black	red
250 ohms	red	green	brown
100 ohms	brown	black	brown
30 ohms	orange	black	black

The .005 mfd capacitors associated with the whistle filter should be of the mica type equal in value and fairly close to the mark. If possible, it is a good idea to have them checked on a capacitor bridge. If not, don't worry about it until you find out from listening observations that the filter is necessary in your particular area.

You will need to find out by experiment which side of the voice coil winding to earth for the feedback loop. Making the incorrect correction will merely give rise to a continuous whistle or howl which is unaffected by any of the controls. In such a case, simply reverse the connections; the correct connection will also drop the auto gain very markedly.

Finally, fit the gang trimmer capacitors at the top of each section of the tuning gang. The top leaf of the trimmer is the one which should connect to the gang frame.

It is some time since we discussed the wide-band alignment procedure and to assist new readers who may not have back issues to which to refer, we will go through the steps again.

In the first instance, set the dial drum drive on the gang spindle so that there is equal overlap of the dial pointer at each end of its travel.

We will assume for the moment that you have on hand or can gain access to a service oscillator and output meter. Clip the meter between chassis and the 6BW6 anode, taking care not to short to other pins or the socket spigot.

Set the service oscillator to 455 Kc, couple it to the grid of the 6AN7 and, with the selectivity switch set to the "normal" position, adjust the slugs in the IF transformers for maximum reading on the meter. Have the volume control full on and keep the output from the oscillator down to a fairly low level to avoid undue AVC action. Start with IFT2 and follow with IFT1, repeating the procedure at least once.

Set the oscillator to 600 Kc, tune it in on the set and, if necessary, adjust the slug in the oscillator coil until it is tuned at the correct spot on the dial.

Set the oscillator to, say, 1200 Kc, tune it in on the set and, if necessary, adjust the trimmer across the oscillator section of the gang until it is tuned at the correct spot on the dial.

Remove the service oscillator output from the 6AN7 grid and transfer it to the aerial and earth terminals.

Leaving the set tuned to the oscillator at 1200 Kc, adjust the trimmers across the two aerial sections of the gang for maximum response.

Set the oscillator to 600 Kc and clip it on the 6AN7 grid. Carefully tune the set to it and, if necessary, readjust the oscillator coil plug. Transfer the oscillator to the aerial and earth terminals, leaving both the set and oscillator tuned to this frequency. Click the selectivity switch to the "wide-band" position.

Shunt a resistor of about .025 megohm across one of the aerial coils, either underneath the chassis or on the gang section itself. Keep the signal level from the oscillator fairly low. Adjust for maximum response the slug in the aerial coil NOT shunted by the resistor.

Remove the resistor, shunt it across the aerial coil just aligned and adjust the slug in the other aerial coil for maximum response. Now remove the resistor entirely.

Leave the set tuned and watch the output meter as the service oscillator

(Continued on Page 111)

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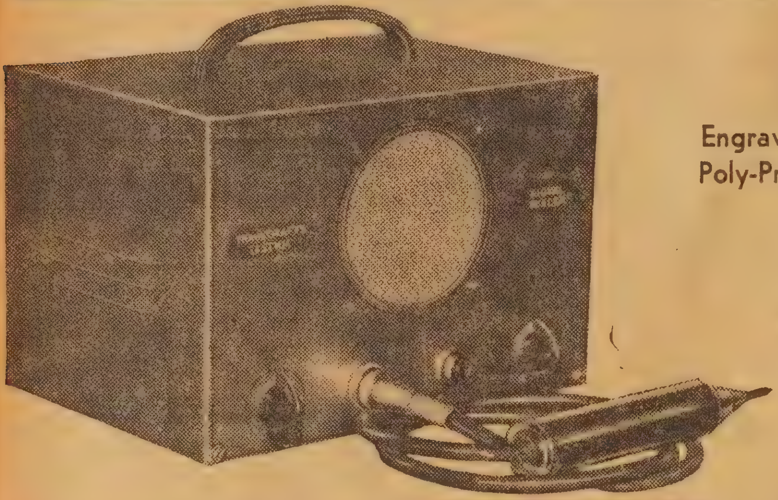

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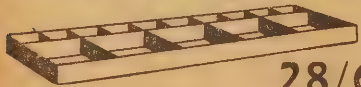

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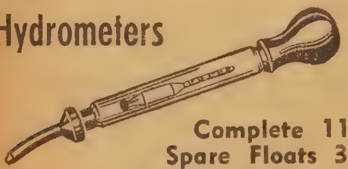

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PHASE SHIFT DISTORTION TEST

The measurement of distortion in audio amplifiers always presents a difficulty unless elaborate equipment is available. This article by Aerovox engineers, suggests a means by which distortion can be assessed using relatively inexpensive equipment.

INTEREST in high-fidelity audio has experienced a phenomenal growth during the past ten years. For many years, the transmitting radio amateurs comprised the largest known group having an avocational interest in electronic equipment. Today, however, authorities estimate that high-fidelity enthusiasts outnumber the "hams". The reasons are fairly obvious.

In the first place, the audio-hobbyist does not need to meet any licence requirements. The inevitable weeding-out process of a technical examination therefore is absent, and a larger number of people automatically become free to pursue their interests. Secondly, audio is closely associated with the enjoyment of good music, something in which an entire family can participate.

The critical audio technician applies exacting tests to his equipment. One such test is distortion measurement. This test is of prime importance, since it rates directly the fidelity of the examined equipment.

STANDARD METHODS

Standard methods of measuring harmonic distortion have, up to this time, used some variation of the following technique: (1) A sine-wave signal of exceptional purity, having a desired frequency, is applied to the input terminals of the amplifier or other device under test.

(2) The amplifier output then is applied to a test circuit in which the fundamental test-signal frequency is suppressed by an appropriate band-elimination filter.

(3) Assuming that no harmonics were present in the test signal, the filter would have zero output voltage. Any harmonics actually present at the output of the tested device would pass through the filter, since the latter is tuned to remove only the fundamental, and would show up as a measurable filter-output voltage. This voltage then may be construed to indicate that the tested device has distorted the originally pure test signal.

(4) This distortion voltage is measured, and the harmonic distortion percentage determined from the ratio of harmonic voltage to the total fundamental and harmonic voltage. For this purpose, the two voltages might be measured before and after the filter. The measurement is made with an oscilloscope or AC vacuum-tube voltmeter.

Several test frequencies through the audio spectrum are employed. This system is the basis of all commercial harmonic distortion meters, which indicate total distortion.

Several difficulties confront the technician in the actual practical application of this method. First, and very important, a pure sine-wave test-signal source is an absolute requirement.

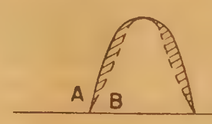
An oscillator or audio signal generator meeting this specification seldom is found outside of the advanced laboratory and is an exceedingly expensive instrument. Indeed, many high-priced audio oscillators are not completely satisfactory for the purpose.

Attempts to correct for the inherent distortion of the average oscillator often give rise to a number of inaccuracies, because of involved mathematical relationships. Furthermore, the distortion tests are complicated and delayed when corrections must be made.

CANCELLATION

The second important difficulty concerns the filters. Ideally, a distortion filter must attenuate the fundamental frequency completely, while transmitting all of the harmonics with no attenuation. The farther you fall from this goal, the greater will be the error due to residual fundamental or attenuated harmonic voltages.

A filter having sufficiently sharp cutoff and low enough attenuation of the harmonic frequencies to permit distortion measurements lower than a few per cent, must be designed critically and must be constructed with expensive high-Q components.



SINE-WAVE INPUT (A) COMPARED WITH DISTORTED OUTPUT(B) OF SAME PEAK AMPLITUDE

FIGURE I.

The third difficulty has to do with the indicating instrument. For best results, this should be a full-wave square law AC vacuum-tube voltmeter, not a common type.

Aside from harmonic distortion checking, the measurement of intermodulation distortion has received considerable attention during recent years. This is a measurement of the interaction between signals of two different frequencies passed simultaneously through an amplifier or other device under test.

Intermodulation tests are favored in many quarters, since they seem to correlate more closely with actual listening tests.

In one system of intermodulation testing (the one credited to the Society of Motion Picture and Television Engineers, SMPTE), a low-and-high-frequency signal are applied simultaneously to the tested device. If the latter has none of the non-linearities which give rise to discords and dissonances in the output, the two signals will be delivered with no interaction between the two.

If this is not true, the output will consist of the high-frequency signal amplitude-modulated by the low frequency.

PROCEDURE

The technique of determining the degree of modulation then consists of the following steps: (1) The modulated high-frequency component is separated by means of a high-pass filter. (2) It then is demodulated and the average value of this signal set to a predetermined reference level by means of a gain control. (3) The low-frequency envelope of the demodulated signal finally is separated by means of a low-pass filter and its amplitude measured with an AC vacuum-tube voltmeter calibrated in intermodulation percentage.

Difficulties also confront the technician in applying the intermodulation method and in interpreting the results obtained. The required high and low-pass filters must have sharp cutoff to prevent interference from the eliminated band of frequencies, and flat transmission throughout the pass band. This requirement dictates costly, high-Q filters.

Also, there is at present, lack of standardisation with regard to the test-signal amplitude ratio, the signal frequencies to be used, and uniform rating of amplifiers in terms of intermodulation percentage.

OTHER FREQUENCIES

Furthermore, separate tests must be made at a number of combinations of low and high test frequencies, in order to compensate for the amplifier frequency response.

It accordingly is insufficient to state that an amplifier has a certain percentage of intermodulation — one must say at what frequency combination the test was made and also with what signal amplitude ratios. There is no simple arithmetic relationship between the intermodulation percentage and a "corresponding" amount of harmonic distortion.

An amplifier should be a linear device, otherwise, it cannot be a faithful reproducer. By linear, we mean that the output signal should follow the input signal directly. If the input is doubled, for example, the output also should increase by twice its original value.

As the input signal waveform goes through its many positive and negative values, the output waveform should go through similar variations, although at higher amplitude (being amplified).

All distortion, whether viewed as harmonic, phase, or intermodulation,

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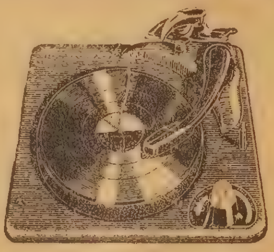

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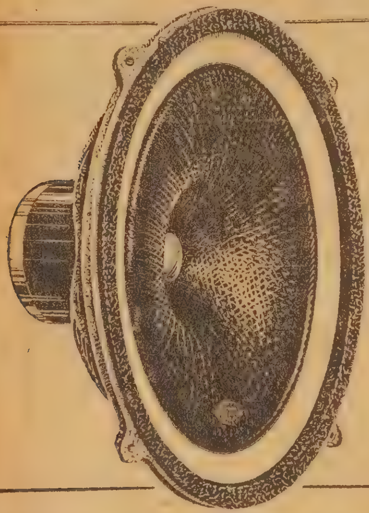

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is a matter of output waveform departing from that of the input signal.

It follows from these remarks that a check of amplifier linearity (output versus input) should establish a great deal with respect to fidelity. Such a test can be performed with any input signal — no expensive, high-purity generator is needed, since a high-fidelity system should reproduce faithfully even a distorted wave applied to its input terminals. Also, elaborate output filters would not be required.

MIXER OPERATION

One method would be to apply, at each selected test frequency, a series of input voltage steps, and to check the corresponding output voltage steps. If the output voltage then is plotted against input voltage, a straight line will be obtained for a true high-fidelity amplifier, having no distortion.

If the line is not straight in any particular, the percentage whereby it deviates from true linearity is an indication of the distortion present. And such non-linearity can give rise to harmonic, phase, and intermodulation distortion.

The foregoing point-by-point method of linearity checking is laborious. It is especially tedious if measurements are to be made at a number of test frequencies and at various settings of volume and tone controls in the amplifier.

Rapid, automatic methods of making this test therefore are desirable. The following paragraphs describe circuits and methods for accomplishing this purpose.

Assume that a sine-wave test signal is applied to the input terminals of an amplifier under examination. One half-cycle of the input signal is shown as A in Figure 1. Now, if the output signal of the amplifier is adjusted to the same peak amplitude and viewed on the same axis as A, provided it is of the same phase, it might appear as B in Figure 1.

The area under curve B minus the area under curve A would indicate the amount of deviation of the output signal waveform from the input signal waveform.

If this percentage is divided by the area under curve A, the distortion percentage would be indicated. The shaded area in Figure 1 shows the difference between the two areas.

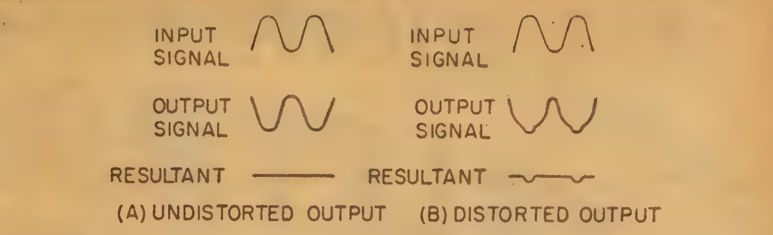
INSPECTION ON CRO

Distortion may be checked in this manner by examining the amplifier input and output signals successfully on the screen of an oscilloscope, being careful to adjust the two signals to the same peak amplitude. For each comparison, the patterns may be pencil-traced on thin paper or may be photographed by double exposure.

This scheme requires that both input and output signals be of the same phase, sometimes necessitating the use of a suitable phase-shifting resistance-capacitance network in case the amplifier under test shifts the phase in the undesired direction.

In the phase-shift method of distortion measurement, the input signal is reversed 180 degrees with respect to the output signal, and the two signals mixed after they are adjusted to equal amplitudes.

If there is no distortion, the two signals being equal in amplitude and opposite in phase (See Figure 2A) will cancel, giving a zero resultant. If, on the other hand, the output signal is distorted, only those portions of the output signal which are equal and opposite to the input signal will cancel.



EFFECT OF MIXING INPUT AND OUTPUT WAVES WITH 180-DEGREE PHASE DIFFERENCE

FIGURE 2.

The other portions, representing distortion (variations from true linearity) will remain, as shown in Figure 2(B) and can be measured with an AC vacuum-tube voltmeter or oscilloscope.

The peak amplitude of the distortion components remaining at "null" may be compared with the peak amplitude of the output signal (with the input signal removed temporarily from the mixing device) to determine the distortion percentage.

If the test oscillator signal is distorted, the two signals still will cancel each other, giving zero resultant, if no additional distortion has been introduced by the amplifier. The reason for this is that (initial distortion included) the input and output signals will be equal in amplitude and opposite in phase in all parts.

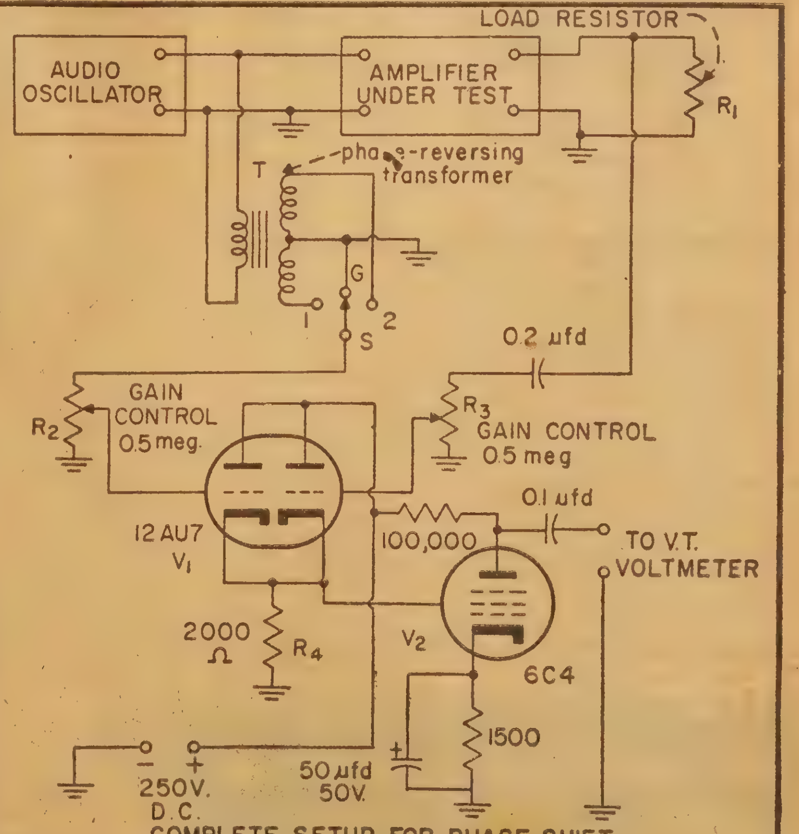
Figure 3 shows a typical complete setup for checking amplifier distortion by means of the phase-shift method.

MIXER OPERATION

In this arrangement the 12AU7 mixer tube, V1, receives signals from the oscillator and from the amplifier output. The amplifier is terminated with a non-inductive load resistor, R1, which has an ohmic value equal to the rated output impedance of the amplifier and rated to withstand at least twice the normal power output of the amplifier.

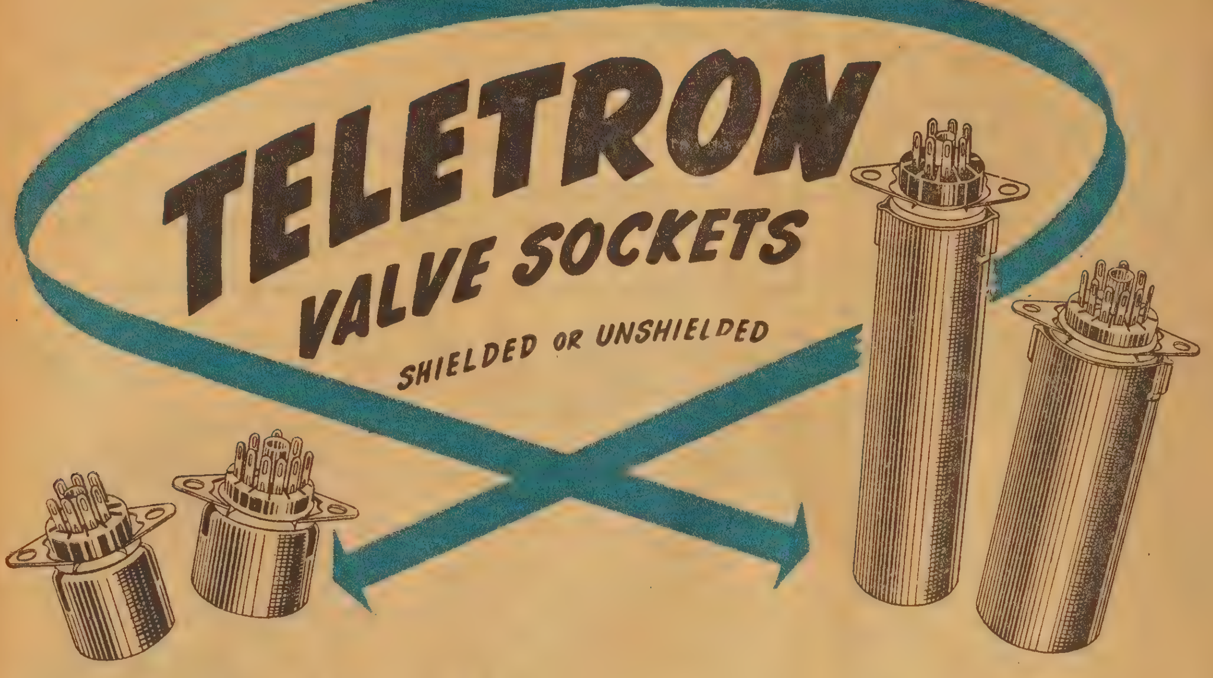
The input signal level into the mixer is adjusted with the gain control, R2, and the level of the output signal by means of the second gain control, R3. These controls are adjusted to make the two signals as presented to the 12AU7 grids, exactly equal in amplitude.

180-degree phase reversal of the input signal applied to the mixer is obtained through transformer T. This must be a high-quality trans-



COMPLETE SETUP FOR PHASE-SHIFT METHOD OF DISTORTION MEASUREMENT

FIGURE 3.



Miniature 7-pin Shielded Sockets

These sockets are constructed of a moulded body fitted with a metal mounting skirt of 5/8in diameter. The mounting holes of the socket are 1/8in diameter at 7/8in centres. These dimensions are standard and agree with those of the standard unshielded miniature 7-pin sockets types ST 27G and ST 27L

The shield cans are available in two standard heights, the smaller one, -/2, to suit 6BA6, 6BE6, etc. tubes and the larger model, -/3, to meet the requirements of the larger miniature 7-pin tubes such as 6AQ5, 6X4, etc. Both types of shields are fitted with a conical spring which provides the recommended spring tension on the valve and it is made from tinned spring steel wire, conical in shape, so that the coils do not interlock.

The physical sizes of both the -/2 and -/3 shields conform to Services specifications and the shield itself is made from drawn aluminium alloy with a hole at the top to provide adequate ventilation and ensures complete protection of the sealing-tip of the valve. The bayonet design provides positive locking and neat fit to ensure continuity of shielding with skirt.

The skirt on to which the external thread fits is of brass cadmium plated with a prior flashing of tin to prevent absorption of cadmium by brass and the sockets can be supplied with skirts less shields if required. This will cater for those requirements where only partial shielding is necessary.

Miniature 7 pin shielded valve sockets	Can Size	Type of Valve	Retail (each)
ST47G black electrical grade bakelite with skirt only	—	Complete series	3/1
ST57G/2 black electrical grade bakelite with skirt and shield	1-15/16"	6BA6, 6BE6 etc.	5/2
ST47L natural mica filled bakelite with skirt only	—	Complete series	4/4
ST57L/2 natural mica filled bakelite with skirt and shield	1-15/16"	6BA6, 6BE6 etc.	6/4
ST57G/3 black electrical grade bakelite with skirt and shield	2-3/8"	6AQ5, 6X4 etc.	5/10
ST57L/3 natural mica filled bakelite with skirt and shield	2-3/8"	6AQ5, 6X4 etc.	6/10
Shield can only, -/2	1-15/16"	6BA6, 6BE6 etc.	2/-
Shield can only, -/3	2-3/8"	6AQ5, 6X4 etc.	2/8

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These sockets are constructed of a moulded phenolic body with a metal mounting skirt, the dimensions being ¾in diameter mounting hole, 1/8in diameter fastening holes on 1-1/8in mounting centres. These dimensions are standard with RCS.1000 and agree with those of the unshielded ST19 noval sockets. The shield cans are of two standard heights and fitted with a conical spring to provide the correct retaining force for all the types of noval valves commonly used.

The ST49G and ST59G types incorporate a high quality electrical grade wood-flour filled phenolic moulded body (black) suitable for general purpose use in the B.C. and S.W ranges.

The ST49L and ST59L types are moulded from mica-filled phenolic (natural) and are suitable for use in the VHF range and other miscellaneous applications and also where low moisture absorption properties are of importance.

CONTACTS are standard miniature type, spring tempered to provide low contact resistance. They are silver plated to provide ease of soldering and are readily held in position by a retaining barb. However sufficient float is provided to avoid straining of metal-to-glass valve base seals.

THE CENTRE SHIELD is of generous proportions to permit adequate shielding between contacts and is tin plated. THE EXTERNAL SHIELD CAN provides sufficient shielding of the valve from external circuits and extraneous fields. It is made from drawn aluminium alloy with a hole at the top to provide adequate ventilation, and the height allows full protection of the valve sealing tip. The external shield cans are available in two sizes:

-/2 — 2in high, designed to accommodate valve types 12AT7, 12AU7, 12AX7, 6AE8, etc.,

-/3 — 2⅜in high, designed to accommodate valve types 5673, 6T8 and the Innoval series, etc.

The bayonet design of the external shields provides positive locking and close fit which ensures continuity of shielding with the skirt

Miniature 9-pin shielded valve sockets	Can Size	Type of Valve	Retail (each)
ST49G black electrical grade bakelite with skirt only	—	Complete series	5/3
ST59G/2 black electrical grade bakelite with skirt and shield	2"	12AT7, 12AU7, 12AX7, 6AE8, etc.	9/9
ST59G/3 black electrical grade bakelite with skirt and shield	2⅜"	5763, 6T8, innoval, etc.	9/9
ST49L natural mica filled bakelite with skirt only	—	Complete series	6/-
ST59L/2 natural mica filled bakelite with skirt and shield	2"	12AT7, 12AU7, 12AX7, 6AE8, etc.	10/6
ST59L/3 natural mica filled bakelite with skirt and shield	2⅜"	5763, 6T8, Innoval, etc.	10/6
CS92 shield can only	2"	12AT7, 12AU7, 12AX7, 6AE8, etc.	4/6
CS93 shield can only	2⅜"	5763, 6T8, Innoval, etc.	4/6

THE SKIRT is manufactured from brass, is cadmium plated with a prior flashing of tin to prevent absorption of the cadmium by the brass. Sockets can be supplied with skirts only where partial shielding is necessary.

SPRINGS incorporated in the shields provide recommended spring pressure on the valve and are constructed from tinned spring steel wire. They are conical in shape to obviate any risk of coils interlocking.

former of the high-fidelity type. An interstage component designed for operation between a single plate and pushpull grids is satisfactory. Switch S allows selection of the proper phase for bucking action in the mixer stage.

The cathode output of the mixer is applied to the grid of a 6C4 distortion-products amplifier, V2. When there is no distortion in the amplifier under test, the 12AU7 output will be zero. Output of the 6C4 is applied to an AC vacuum-tube voltmeter or oscilloscope for measurement of the distortion voltage and examinatioin of its waveform.

The setup, as shown, will give satisfactory results in the majority of applications. However, when phase-shifts within the amplifier (or network) under test are not of the order of magnitude other than those encountered in conventional amplifiers, it may become necessary to insert a simple R-C phase-shifting network, designed for use at the test frequency, in series with one of the signal leads to the 12AU7 stage.

TEST SET-UP

The instrumentation is operated in the following manner: (1) Set the oscillator output voltage to drive the test amplifier to its full power output (output is E squared/R1, where E is the voltage measured across load resistor R1 with a high-impedance-input AC vacuum-tube voltmeter).

(2) Connect an oscilloscope or AC vacuum-tube voltmeter to the 6C4 output terminals.

(3) Adjust gain controls R2 and R3 for null-minimum deflection of the meter or 'scope.

(4) If complete null cannot be obtained with switch S in its position 1, throw to position 2 and readjust the gain controls. Select the setting of switch S which gives the lowest reading.

(5) Read any voltage remaining at the best obtainable null and record this as E1.

(6) Remove the oscillator voltage from the 12AU7 by setting switch S half-way between its two contacts and thus grounding the grid.

(7) Read the voltage then indicated by the meter. This is the full amplifier output including distortion components, and must be recorded as E2.

(8) Determine the distortion percentage (D) by means of the formula: D (pc) equals E1/E2.

CRO AN ADVANTAGE

There is an advantage in employing an oscilloscope as the 6C4 output indicator. The 'scope permits an examination of the signal waveform, as well as its peak voltage value. This often is invaluable in determining the nature of the distortion and helps to determine what remedies should be applied for its correction. It is good practice to use the 'scope even when a VT voltmeter also is in the circuit.

The setup shown in Figure 3 illustrates the basic essentials of any circuit for checking distortion by the phase-shift method. Many variations are possible, and the reader may introduce obvious refinements which might appeal to him.

An entire distortion meter might be constructed, for example, with a self-contained power supply and built-in VT voltmeter or miniature oscilloscope. It is possible also to build the distortion meter into the same case with an audio oscillator.

THE LATEST GEX MODEL CRYSTAL SET with Germanium permanent fixed crystal detector. In leatherette covered case, size 6in x 4in x 2½in, £4/6/9. Complete with headphones, £6/5/-.

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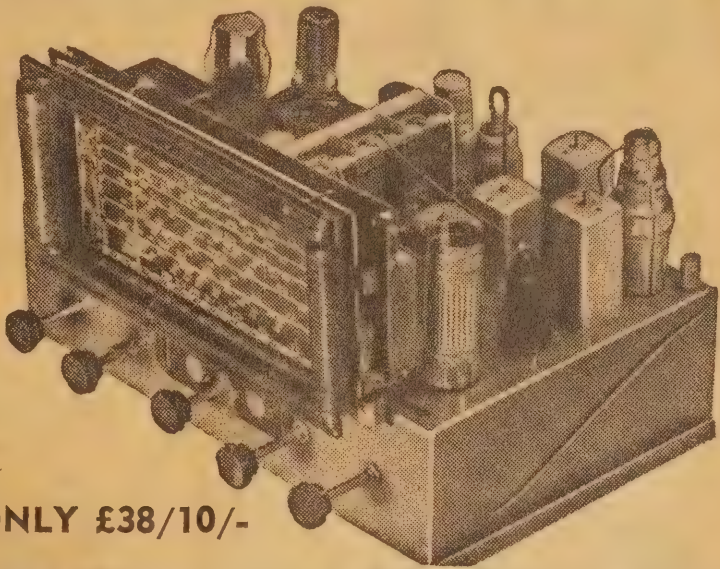

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240 volt A.C. models complete ready for use (without cabinet, microphone or pick-up).

3 valve with 8in speaker, £12/17/6 (suitable for phono pick-up only, 4 watt output). 12in speaker £1 extra.

4 valve midget with 8in speaker, £13/15/- (suitable for phono pick-up and microphone, 4 watt output). 12in speaker £1 extra.

5 valve with 12in speaker, £21/10/- (suitable for phono pick-up only, 8 watt output).

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Let's Buy An Argument

After three weeks of relaxation on the northern beaches, it brings one very solidly back to earth to find on the table a month's accumulated mail. Among the greetings (which I heartily reciprocate), the suggestions and the queries, I came across a missive from a very agitated reader, K. H. of Bexley, N.S.W. Read it first or the following remarks won't make sense:

by Neville Williams

FORTUNATELY, for my own peace of mind, the correspondent is not quarrelling with any statement in these columns, but, rather, with an article on electroplating on page 105 of the December issue.

It so happens that this article, by E. H. Morgan, is not the work of a local writer at all, but was reprinted from an overseas magazine by a special arrangement we have with them. Without a lot of effort and delay, therefore, the author is scarcely in a position to reply on his own behalf.

THE FINER POINTS

There has since been some correspondence in the said magazine devoted, for the most part, to the finer points of electroplating. I prefer not to comment, for my own experience in that field is largely confined to the front counter of the local plating works.

For all that, however, the letter from K.H. set me thinking, and there's just a chance that it may have the same effect on you.

On the surface of things, the article and the letter merely involve the statement, or misstatement, of accepted "facts". The author set out, presumably, to produce a single article that would tell the reader how to electroplate small articles and to give him some idea of what goes on when he does so.

I leave you to judge whether his efforts as a writer justify the charge that he "has scraped up any old rubbish from whatever source was available".

I seriously doubt it!

Because a couple of points in technique are involved, I have taken the liberty of extracting for publication some additional remarks of the author. Obviously, he has not been called upon to "explain" the statements condemned locally by K.H.

These statements involve, firstly, interpretations of the atomic theory or the electron theory, whichever you like to call it.

On the surface of things, K.H. is quite correct when he claims that the electron is larger than the proton, though some authorities vary from his quoted figures by a few places.

FAR HEAVIER

Mysteriously, however, the proton is credited with being many times heavier than the electron, actually by about 1840 times. Since the writer of the original article quotes figures of mass, it is not clear whether he failed to appreciate the unexpected difference in dimension or whether he merely chose the wrong adjective in the word "larger"

Coming to the second point, there are any number of textbooks which will tell you that electrons do indeed revolve around the nucleus in well defined paths, like units of a planetary system; that the paths are subject to external influence, as, for example, to the dielectric stress apparent in a capacitor.

One has to contradict the said textbooks, as well as friend Morgan, to uphold the "cloud" idea.

Don't get me wrong. I'm not suggesting that textbooks are infallible, but merely that E. H. Morgan has plenty of backing for this statement.

HAS THINGS MIXED

His definitions of "anions" and "cations" are clearly back-to-front, however. My technical dictionary defines an anion as "the ion in an electrolyte which carries the negative charge and which migrates toward the anode under the influence of an applied potential difference".

Cations are their electrical opposites.

The ease with which the terms could be confused is obvious. I always get mixed up between stalactites and stalagmites!

So much for that. I find K.H.'s reference to current flow rather unconvincing by contrast to his other statements. It smacks very much of the old crack about "that's my story and I'm stuck with it".

At this present date it seems so obvious and so simple to think of current flow as a migration of electrons that it's very hard to justify any other kind of mental picture. We've been through all this before, of course.

As a radio magazine (and as radio types) we must think in terms of electron movement and keep out of trouble by talking about electron flow rather than current flow. But occasional arguments are inevitable if the term "current" is not to be dropped from our vocabulary.

I wouldn't like to shoot the author down, either, on the strength of his figure 3, particularly as he has gone to pains in the article to explain the movement of ions in the electrolyte.

I grant, however, that many such diagrams can be criticised on the same score, particularly the host of basic diagrams showing the flow of current through a valve and battery circuit. Taken on their same face value, they all seem to suggest that electrons move freely through the valve, the wires and the battery.

WHAT TO DO

The alternative would appear to be so obvious: You mark all drawings with captions and labels which indicate that the flow of electrons in this part of the circuit is replaced by the migration of ions through electrolyte!

Unfortunately, a student's concentration is likely to be so upset by such a thought that it may divert his attention from the main task of learning about valves. Hence the authors' fervent hope that the student doesn't think about such difficulties until he is ready to explain them.

I'm afraid that such tacit omissions are commonplace in any course of study. In fact, for an example, one needn't go farther than the very theory we have been discussing—that of electron flow.

As I said earlier, our worthy fathers needed to sort out their ideas of current flow and settled on a purely arbitrary standard. It remained quite adequate while ever their thinking was confined to ordinary electrical circuits.

As the conception of the electron grew, however, so the difficulty became more apparent of sustaining the original definition. Gradually, it is being trodden into the dust by a whole new generation of radio and electrical engineers. It has served its purpose!

WHAT ARE ELECTRONS?

In like manner, the electron theory is serving its purpose. Students are taught that electrons are (or behave like) very small particles of matter, having a negative electrical charge.

Protons, neutrons and such like are other basic fragments having differing characteristics.

Scientists have "measured" and "weighed" these minute particles, using the same basic units of dimensions and mass that you'd apply to a lump of coal. Their behavior has been charted and predicted and put to very good use.

All this has been quite adequate for humble souls like ourselves, who deal in wires and valves, read physics textbooks and, perchance, plod along in the ordinary realms of chemistry.

It is most helpful to consider electrons and suchlike as tiny chunks of matter and proceed thereon to erect a whole series of mental pictures.

ABOUT ELECTROPLATING ARTICLE

A LOT OF RUBBISH!

I wish to bring to your attention the inaccuracies contained in the article "How to Electroplate at Home", published in the December issue of Radio & Hobbies.

In the past, articles written by Radio & Hobbies staff have been accurate in all respects. This article appears to have been concocted by a person who "hasn't a clue" on modern atomic theory, but has scraped up any old rubbish from whatever source was available.

In the first half dozen lines, the author states. "For reasons of mechanical strength and ease of working, the two metals most commonly used in engineering are iron (including steel) and brass." He neglects entirely the major factor of economy.

Now for the "atomic theory". The proton is NOT a relatively large particle as is blandly stated. Along with the neutron these particles (in simple—which is rather appropriate in another sense—atomic theory with which the author deals) are the smallest constituents of the atom. They have a radius of approximately 10 to the minus 21 cm. The electron on the other hand has a radius of approximately 10 to the minus 16 cm and yet the author calls this "extremely minute" as compared with the "relatively larger" proton.

The electrons do NOT revolve in "well defined orbits" as the author states, but rather they exist as electron "clouds". If a particular electron is selected in an atom its "average" distance from the nucleus is constant (providing the external environment is constant)

Obviously stating what is correct cannot in any way tend to complicate a simplified version of any treatment, and what is not stated is in no way harmful to the reader (within limits). Hence if the author had wished (as he apparently did) to compare the sizes of a proton and electron stating the comparative sizes correctly would have been no more affecting his "amplified" atomic theory than stating them as he did.

Then comes the "daddy of them all". He calls an ion possessing a unit positive charge to use his own words "a positively charged atom" an anion. Does this person know anything about anything? Does he not realise that "positive ion" migrates to the cathode when the circuit is completed and is hence known as a cation? Similarly, a "negative ion" is known as an anion.

I feel that the statement on current flow could be misleading to many. The actual direction of current flow is only different from the conventional, in that the conventional deals with a flow of protons. In normal materials under normal conditions protons do not exist other than in the nucleus of the constituent atoms and are hence unable to take part in current flow.

However the basic direction of current flow is the same; a flow of electrons in one direction representing a flow of protons in the opposite direction and vice-versa. This point was not obvious from the article.

According to the diagrams on "electron flow" the electrons flow through the electrolyte. Oh well! and Dearie-me! If they flow through like so, we can't electroplate so what the heck?

K. H. (Bexley, NSW).

AUTHOR'S FURTHER COMMENT

(As already published overseas and not in reply to the accompanying letter from K.H.)

I must express my thanks to the correspondent for pointing out an error in the current density quoted in my article on electroplating. The correct current density should be 0.02 amps sq. in and not 0.2 amps sq in for silver.

With regard to the other points, I have the following observations to make.

Admittedly, the most versatile plating bath for copper is the cyanide bath, but this bath is quite complex in composition and moreover is of an exceedingly poisonous nature. It was my intention, where possible, to avoid suggesting the use of a cyanide bath and to this end I included copper plating as merely an initial exercise.

In order to make the record complete, I include below a formula which is admirably suited for plating ferrous metals, and which is comparatively innocuous.

Copper sulphate	2oz
Sodium potassium tartrate	5oz
Sodium hydroxide	2oz
Distilled water	2 pints

The diagram in Fig 3 (a and b) is perfectly correct as far as it goes. Of course it makes no attempt to explain the current flow in the electrolyte. This flow is quite complicated and invovles the migration of positive ions to the cathode, and negative ions to the anode.

That is not the whole story, for besides ions of the radicals concerned, hydrogen ions and hydroxyl ions are also present, and have to be taken into account in any complete theory.

Your correspondent thinks I am optimistic about amateur's chances with chromium plating. In face of this I can only repeat what I have already said in the article, aud that is, that if the instructions are followed carefully and exactly, there is no reason why an amateur should not obtain successsful results.

The only real difficulty that I have encountered with chromium plating, is getting the action to start, and this is easily overcome by momentarily passing a somewhat higher current density than that calculated from the formula.

E. MORGAN.

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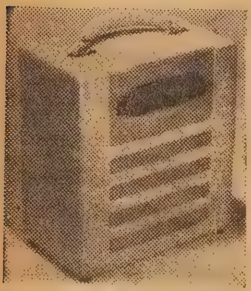

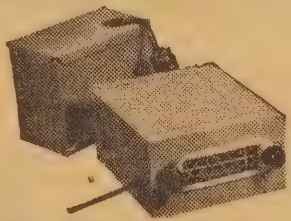

Illustrated: Top—Jubilee Portable. Bottom—Karset.

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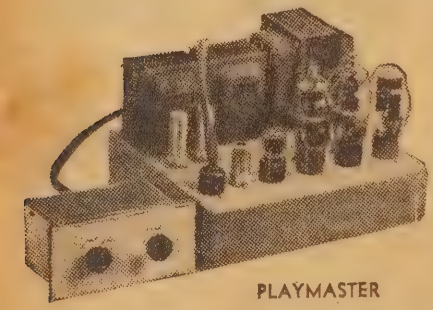

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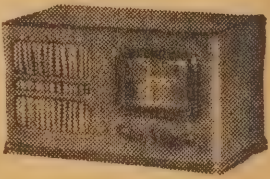
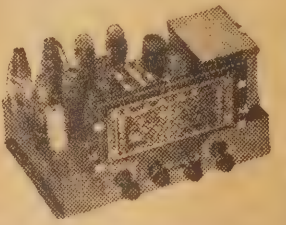
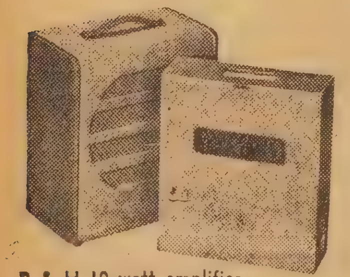


E.P. have a large range of sets specially designed for home use. They range from a small 1-valve beginners receiver to 2 and 3-valve bedside sets, mantel and table models. There are numerous AC models available including small and super-de-luxe radiograms, whilst the countryman is catered for with battery-operated, vibrator-operated, and 32 volt receivers. There are nearly 100 sets featured in E.P.'s Kit Set Catalogue.



Illustrated: Fireside 5, and Vibragram 7.

. . . for the Technical Minded!



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But to those dealing with the higher realms of physics, this "corpuscular" conception of the electron is completely inadequate. It just doesn't work out as it should.

Basic matter, as seen in the atom, is linked intimately and irrevocably with energy. One can't be sure where one finishes and the other begins, or whether there's any line of demarcation between them at all.

If such is the case, how can one possibly attribute physical dimensions and weight to particles of matter that aren't really particles of matter at all?

APPARENT CONTRADICTION

But, contrariwise, if you say that electrons, protons, neutrons and so on are merely electrical charges having no tangible qualities, why do they behave as particles in many highly specialised experiments? Or why, one might facetiously ask, is a brick so hard?

The point is that these minute "things", which we blandly refer to as charged particles or a unit of electrical charges, behave consistently as neither. They appear to have dimension, mass and potential, yet behave in other circumstances like a kind of wave train or a "solid store" of energy.

Let me quote a recent paper on the subject, delivered at an international conference at Geneva:

"The established view today is that everything is at the same time both particle and field. Everything has the continuous structure with which we are familiar in fields, as well as the discreet structure with which we are equally familiar in particles. This concept is supported by innumerable experimental facts and is accepted in general, though opinions differ on details. . . .

"The difficulty of combining these two so very different character traits in one mental picture is the main stumbling block that causes our conception of matter to be so uncertain."

NO END TO IT

So it goes on, a sort of "La Ronde"!

We have group 1, workers in traditional electrical circuits, still using their traditional concept of current flow, &c., even though its limitations are apparent.

We have group 2, ourselves, basing our concepts on the electron theory and reasonably happy therewith, despite known limitations.

We have group 3, those in the forefront of nuclear research, who can no longer accept electrons and protons on their face value.

Right now they are trying to evolve a concept which will be as valuable to them as the electron theory has been to research workers in radio and allied fields.

Until such a concept is evolved and translated into workaday mental pictures, the objectives and accomplishments of nuclear research workers will largely remain a mystery to the most avid students of "popular science".

Few of us can understand anything till words are available to explain it. And who can explain something he doesn't understand?

When and if such a conception is evolved, a mental picture, it will serve its purpose for a time. We presume, however, that it, too, will be foredoomed to inadequacy, as scientists dig deeper into the secrets of the universe.

If such a mental picture is not so foredoomed, we've come pretty close to suggesting that we are about to comprehend the ultimate.

You must pardon me if I seem to doubt.

All this is a long way from where we started but what does it matter? It's just that we should not be too "cocky" about our pet ideas.

As time goes by, we must be prepared to "unlearn" convenient fictions and assumptions:

Current doesn't flow that way at all. . . .

DEFENDS DESIGN OF TAPE DECK

(In answer to a letter which appeared in the November issue, querying Mr. Thomas' tape deck article.)

To reply to Mr. R. T.'s letter. He takes exception to the choice of a 3½in diameter flywheel, advocating one about 15 pc bigger; to the capstan speed; to the capstan diameter; and to the choice of motor. He implies that the unit can't possibly work without an intolerable amount of wow and flutter. These criticisms are a little drastic, apart from being inaccurate.

Because Mr. R. T. has had some bad luck with the FP 10 motor (used in the MU 10, MU14, &c, turntable units) he condemns it for eternity. Obviously he has not tried using it in the layout described in the article, where it has adequate power for its purpose. There is no takeup reel to be driven, and in fact the takeup motor does actually handle some of the work of moving the tape past the heads.

The answer to his rather naive question, "why the very large capstan?", is that this gives a tape speed of 7½ ips at the capstan speed involved—a little over 200 rpm. He implies that designers universally abhor large capstans, and strive to turn up (or turn down) smaller and smaller versions.

That his experience has been limited to designs using smaller sizes is possible, but whence came this idea that only "low quality commercial recorders' use capstans as big as ½in? Some of the better-class recorders use much larger capstans.

A high-fidelity recorder using 30 ips with a 1in capstan would have a capstan speed of about 600 rpm—not an unlikely figure. Mr. R. T.'s 3/16in capstan would have to turn at about 3000 rpm.

In the extreme cases, I have come across capstans of up to 4in in diameter. Those driven by a 78 rpm motor have a diameter of about 1.8 in.

The truth, of course, is that the capstan size in itself is not fundamentally important except in special cases; rather it is the speed of rotation which is chosen to suit the purpose in view, or perhaps determined by external factors, and this in turn determines the capstan diameter. A lower speed requires a large or a heavier flywheel, but a higher speed causes more friction and wear and so on. No one may say dogmatically that this speed is too high, or that too low.

As a lot of misunderstanding and ignorance seem to surround the subject of ballraces in tape recorders, it would be as well to clear the air by setting out the facts. In doing so I may reiterate somewhat the remarks you made in the November issue, but as the matter is an important one this may perhaps be excused.

Just as the turning and other metal work, particularly that connected with the flywheel and capstan, must be accurately done to get good results, so must the bearings—ballraces or otherwise—be of good quality to reduce flutter and rumble. This was emphasised in Part One of the article.

Although fair results might be obtained with low-grade ballraces, it would be foolish to risk spoiling the job by trying to "get away with" cheap races which in some cases have appreciable play and irregularities.

It was mentioned in the article that precision races should be used. This does not mean, however, that they have to be specially selected. Any good quality ballraces of reputable make should be satisfactory, and there is no reason why the performance of the original unit, which used Hoffman races, should not be duplicated.

Good ballraces can sometimes be found in disposals equipment, and there is no harm in trying these if they are of standard sizes, since if they should be unsatisfactory new races can be fitted into the same housings.

To object to the use of ballraces because they have to be oiled is equivalent to objecting to the use of a superhet circuit rather than a TRF, because the superhet uses IF transformers which have to be aligned.

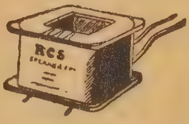
The suggestion that "a bad bump" will damage a ballrace is, as applied to tape recorders, completely frivolous. One can break a glass valve by dropping it on the floor, yet they are used in radio sets and amplifiers in spite of this drawback.

Many professional and commercial recorders use ballraces, with excellent results. By using good quality races, a home constructor can also achieve gratifying results. By all means, let him use Oilite or similar bearings if he prefers them. But let him not do so under the impression that ballraces are unsatisfactory.

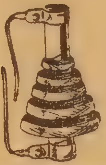
In conclusion, may I congratulate you on your article on the construction of heads. I have built some very successful heads along the lines which you describe, without meeting any insuperable snags.

Yours faithfully,
P. D. Thomas.

REPLACEMENT PARTS



Filter Choke.



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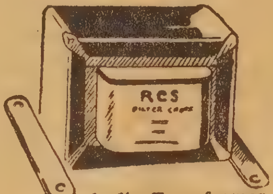

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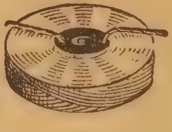

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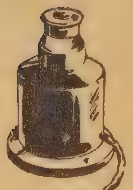

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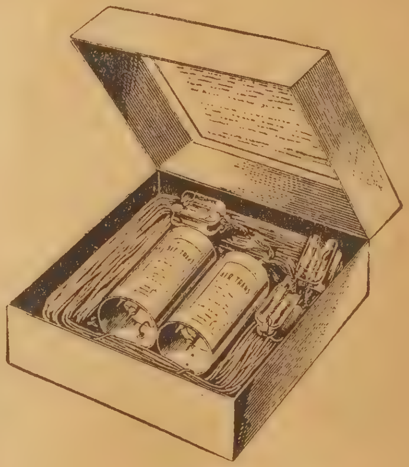
2. If the noise continues, you need an LF20 line filter as the noise is coming through your power main
3. If any electrical appliances are causing the noise then fit a line filter.



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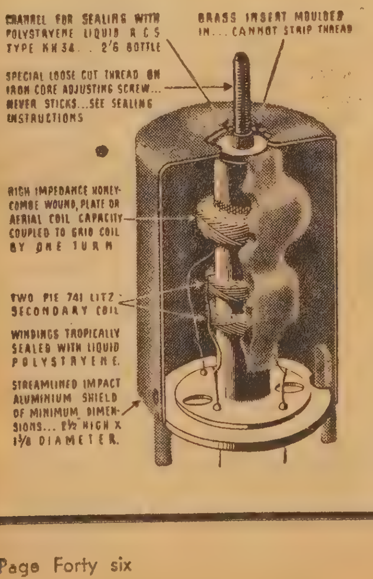
AERIAL FILTER
140/-



CHANNEL FOR SEALING WITH POLYSTRYENE LIQUID R C S TYPE KH34. . 2/6 BOTTLE
BRASS INSERT MOULDED IN... CANNOT STRIP THREAD
SPECIAL LOOSE CUT THREAD ON IRON CORE ADJUSTING SCREW... NEVER STICKS...SEE SEALING INSTRUCTIONS
HIGH IMPEDANCE HONEYCOMBE WOUND, PLATE OR AERIAL COIL CAPACITY COUPLED TO GRID COIL BY ONE TURN
TWO PIE 741 LITZ SECONDARY COIL
WINDINGS TROPICALLY SEALED WITH LIQUID POLYSTRYENE.
STREAMLINED IMPACT ALUMINIUM SHIELD OF MINIMUM DIMENSIONS... 2½ HIGH X 1⅜ DIAMETER.

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Without any doubt no other radio component requires such care in impregnation and precision in manufacture as coil winding. Behind every R.C.S. Coil there's a great story of precision and painstaking manufacture and assembly, to the very highest and most exacting electronic standards. Without doubt, for design, precision and stability, the standard range of R.C.S. Coils are equal to any produced in the world. You are assured of the highest standard of performance from your circuit when you use R.C.S. Components.

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R.C.S.

RADIO PTY. LTD.,
651 FOREST ROAD,
BEXLEY. LW3491

Electrons don't just circulate through batteries. . . .

Matter isn't just a structure of elemental particles. . . .

Articles, ideas and textbooks notwithstanding!

* * *

At this stage let me change the subject abruptly and suggest that you read Mr. Thomas' reply to criticism which appeared as long ago as the November issue.

You may remember that a couple of readers objected to his suggested tape deck design because, among other things, it used ball races. It used a motor of rather low torque and a flywheel capstan set up giving allegedly inadequate safeguard against "wow".

There is surely no need for me to comment at length, since Mr. Thomas' powers of expression are in no way lacking.

TAKE-UP SYSTEMS

One thing I do suggest, however, is that not all tape experimenters appreciate the significance of the take-up system in the overall performance of a deck.

As often as not one starts off with a reel of good tape and adjusts a slipping belt or clutch so that it takes up smoothly with a minimum load on the capstan motor. It seems so delightfully easy.

Later on, the tape deteriorates or a bad reel turns up, which tends to wind into a floppy triangle, overrunning the take-up spool before it is halfway through. The take-up tension has to be increased, loading the capstan motor to capacity and jerking the capstan for good measure.

You either go grey trying to adjust the thing, or discard the whole reel or condemn the motor as too weak. None of the possible conclusions are convincingly final.

The vital point about Mr. Thomas' capstan drive is that it has no groove for a take-up belt and is intended for use with separate reel motors. I agree that this point could have been made more obvious to the reader, though the intention can be deduced from the article.

This fact completely alters the picture because the take-up power comes from a second motor and the tape tension helps pull the capstan motor round instead of loading it adversely.

Mr. Thomas' comparison between ball races and IF channels is rather unconvincing. It would go better as an argument for the oilite variety. After all, IF channels are something you fit, fix and forget. For the rest, the story is clear enough.

WORDS AND MORE WORDS

In conclusion, may I quote a letter from a gentleman of some statue (or is it stature?) in the legal fraternity.

Dear Sir,

The study of human emotions has always been of great interest to the writer who was amused at the mental gymnastics exhibited in the January issue in the "Argument" column.

The writer derived a great deal of pleasurable amusement from the account of your frenzied endeavors to answer a simple technical question propounded by the editor.

On behalf of a client, some years ago, the writer took the opinion of a very eminent barrister, on a certain technical point and, after reading 21 pages of discussion, was no wiser, or perhaps was even less wise, than when he commenced to read the opinion.

Not being a wonderful technician the writer's store of knowledge was not increased by the alibis set up by you. However, to his delight, he then read with astonishment and joy the attack on an audiophile, which the writer has a strong suspicion was directed to him.

Leaving aside new technical terms such as "cathode follower" the writer was reminded of two things; one, the thought of the fisherman who casts a line at a venture and gets hook, line and sinker taken, and the other that a simple submission to you of an unusual looking circuit evolved such a tirade against DC amplifiers and cathode followers.

It is probably about 30 years ago that the writer, then struggling with interstage audio transformers and suchlike abominations, read in an up to date magazine of the time (not THE Publication) of the direct coupled circuit. He made one of these up and, without knowing anything about impedance, very little about audio frequencies, and in fact possessing only a smattering of radio knowledge, was so delighted with the wonderful improvement in reproduction, that he became an arden direct coupled enthusiast.

You must remember that in thos days loudspeakers were poor i design, there were few models t choose from and the quality of output transformers was very low. Th writer's enthusiasm therefore for th direct coupled amplifier, which h certainly has not used for 15 or 2 years, might possibly be excused a after all one's first love leaves a long and ineradicable impression.

The writer is reminded, as a fina parting shot, of the delightful duet in the "Yeoman of the Guard" in which the expressions "What a lot of cock, what a lot of bull", might with your permission (as it is certainly with writer's), be applied to your attack and this reply.

Yours faithfully, &c.

As I read through to the last few of lines, I could not help but think of another song which seemed to fit the occasion. It recounts the amours of a character between the ages of 17 and 35 (what conservatism) and ends with the touching lines . . .

"And when he thinks he's past love,
Ah, 'tis then he finds his last love
And he loves her as he's never loved before".

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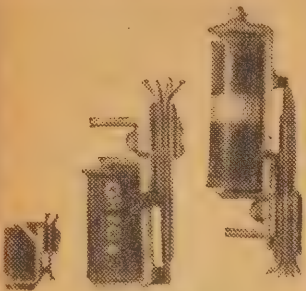

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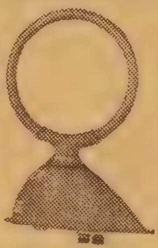

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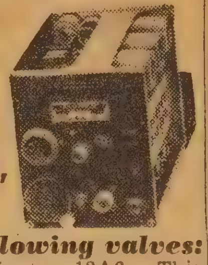

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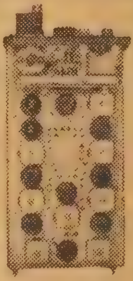

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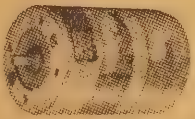

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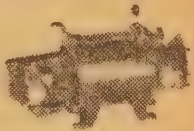

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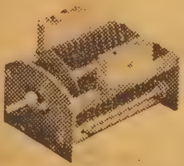

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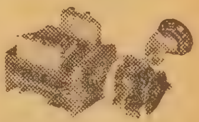

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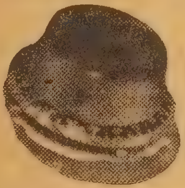

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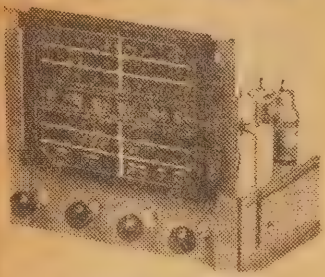

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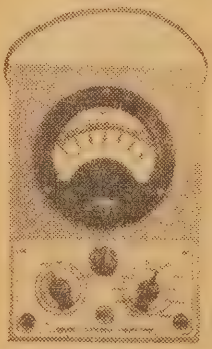

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8in SPEAKERS	5/6	9/6
6in SPEAKERS	5/-	8/6
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AIDS TO INDUSTRIAL ELECTRONICS

PART 4 — CONTROL AND INVERTER CIRCUITS

After having discussed various industrial type control tubes, this last article in the series details some of the circuits in which they are used. Mention is made also of DC to AC inverters.

THERE are almost limitless ways of applying gaseous tubes to control operations. In general, a method may be found for employing the advantages of these tubes in any system in which their power-handling capabilities are not exceeded.

Where the controlling current or voltage is of a low order of magnitude, appropriate vacuum-tube amplifiers may be called into service to raise these impulses to the level required by the control grid.

By an adequate combination of photocell, vacuum-tube amplifier, and gaseous-tube circuit, even the tiny amount of energy in the light from a distant star might be utilised to start up a heavy electric motor or to turn on all the lights of a large exposition.

Figure 1 shows one of the simplest gaseous-tube control circuits. V is the thyratron or other gas-filled rectifier, arranged to control the load circuits.

OPERATION OF CIRCUIT

R2 represents the load which may consist of a relay, motor, heater, or similar device to be actuated by the DC output of the tube. The anode supply is either AC or DC. R1 is an input shunt resistor across which the control current develops grid voltage.

This component might be the load resistor in a vacuum-tube rectifier interposed between an amplifier and the gaseous tube when working with tiny control currents. S is a circuit-opening switch employed to interrupt the anode current momentarily to deionise the tube when used with a DC plate supply.

When direct current is supplied to both anode and grid in this circuit, the anode will normally be connected to the positive pole of its supply. The polarity of the grid voltage will depend upon whether the tube is positively — or negatively — controlled.

The value of steadily-applied control voltage developed across R1 must be maintained at, or slightly higher than, the critical value for ionisation. A reasonable reduction below this level will then trigger off the discharge and maximum current will flow through the load, R2 until deionisation is accomplished by means of the switch, S, or a reversal of the anode voltage polarity.

Control of this circuit is achieved either by reducing the steadily-applied grid voltage or removing it entirely from the grid.

The anode supply might likewise be an alternating voltage, whereupon control action will remain substantially the same and rectification will be obtained through the tube.

If both anode and grid voltages are alternating, the tube discharge will be controlled not only by the magnitude of the grid voltage but its phase as well, and control will be restored to the grid each time the anode voltage passes through zero.

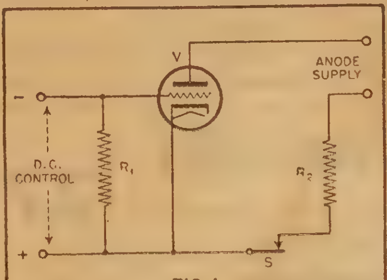


FIG. 1

In Figure 2, a gaseous triode is shown supplied with alternating potentials from a common source. A cathode tap on the secondary winding of the transformer, T, is placed to that the anode voltage, Ep, is developed by one section of the secondary and the grid voltage, Eg, by the other section.

It is evident that the anode and grid voltages are 180 degrees out of phase with each other.

The grid voltage will be negative when the anode voltage is positive, a satisfactory condition for a negatively-controlled tube. However, the tube discharge will not be initiated until the negative half-cycle of grid voltage is at the ignition point for instantaneous anode voltage.

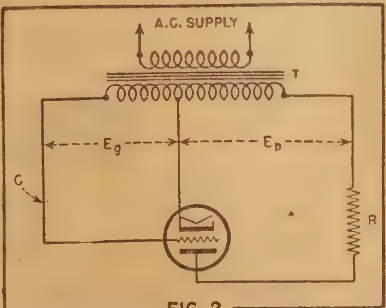


FIG. 2

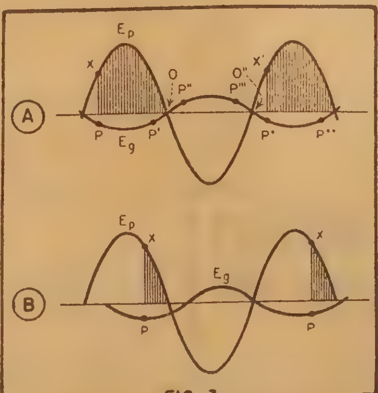


FIG. 3

Reference to the two diagrams, A and B, of Figure 3 will clarify the mechanics of this process. Diagram A depicts the anode voltage alternations of the wave Ep and opposite-phase grid-voltage alternations by the wave Eg.

Shaded portions of the positive half-cycles of Ep indicate intervals during which anode current flows through the load, R (Figure 2).

GRID VOLTAGE

Assume that the grid voltage level, P is the ignition potential for the particular plate Voltage X. The grid voltage half-cycle will again reach this value at P', and on succeeding half-cycles at P", P"', P* and P**.

In such case, anode current will begin to flow at this grid voltage, P, as indicated by the shaded portion of the first Ep half-cycle. However, when Eg next passes through the ignition potential at point P', the discharge is not extinguished for the reason that the grid lost further control after point P.

The discharge continues, therefore, until the anode voltage reaches the zero line (point O), when Ep is interrupted long enough for ionisation to be curtailed and grid-control restored.

When Eg again reaches the ignition potential at P" and P"', it is of no consequence, since the anode potential has swung into the negative half-cycle and conduction does not occur. Not until the Eg ignition potential is reassumed at P*, when Ep is again positive, does conduction occur.

INTERVALS OF FLOW

It will be observed from the shaded areas that conduction exists during the part of each positive half-cycle of anode voltage between the instant of firing and the end of the half-cycle.

These shaded areas may be widened or narrowed (with the same values of alternating anode and grid voltages) by moving the Eg curve horizontally along the horizontal axis, changing its position with respect to the Ep curve.

This is equivalent to stating that the interval of current flow may be lengthened or shortened by shifting the phase of the grid-voltage.

Diagram B in Figure 3 shows the result of shifting the Eg curve somewhat to the right, the Ep curve remaining stationary. Here, the points P and X correspond to identical values in Diagram A, but notice the shorter interval (shaded area) during which the tube conducts current.

Grid voltage phase shifting obviously cannot be accomplished in the unaltered arrangement shown in Fig. 2. However, simple circuit additions are possible whereby the Eg phase may be shifted over a useful range.

For example, the grid voltage may be obtained through a fixed capacitor inserted into the circuit at point C and a plate-to-grid variable resistor employed for phase-shifting adjustments.

The conducting interval in each positive half-cycle of anode voltage will be inversely proportional to the setting of this resistor and it will extend over the entire half-cycle when the resistance is cut out entirely, the anode and grid voltages being in phase at this setting.

Numerous methods for starting and stopping gaseous tubes by means of phase shifting have been devised. Some of these systems, abundantly described in the literature on these tubes, employ manual means of adjustment and others are fully automatic in operation.

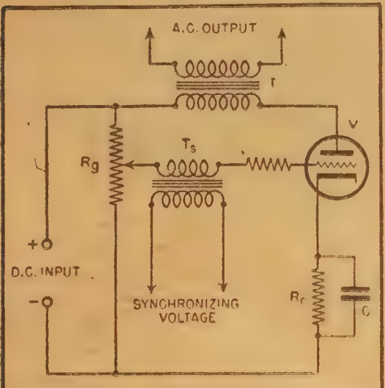


FIG. 4

In the latter category may be included the practice of placing a photocell between anode and grid in the arrangement described in the preceding paragraph. Here, the varying resistance of the photocell replaces the manually varied resistor.

Still other phase-controlling circuits utilise bridge arrangements of resistance and inductance. In general, any of the familiar phase-shifting networks may be employed for gaseous-tube control.

Individual experimenters will find the entire subject of phase-controlled gaseous rectifiers fertile territory, since almost limitless arrangements may be worked out for particular applications, such arrangements might make use of grid voltages of various magnitudes, frequencies, and waveforms as individual requirements dictate.

INVERTERS

The inverter is an electric device for converting direct current into alternating curent. Its chief novelties are its fully electronic action and general compactness, although this device has not yet supplanted the rotary converter, motor generator, and vibrator transformer.

In inverter circuits, gaseous tubes perform the function usually carried out by mechanical circuit interrupters—that of commutating direct-current flow through the primary winding of a transformer to induce an alternating current in the secondary.

The fact that the firing rate may be controlled in the gaseous tube makes possible this action in the primary-circuit. During discharge periods, tube current flows through the transformer primary; and during periods of deionisation, it is stopped.

By proper choice of certain circuit components (particularly by arranging resistance - capacitance circuits to obtain proper time constants), the number of conduction intervals per second, and, therefore, the frequency of the secondary voltage, may be determined.

A representative, basic one-tube inverter circuit is shown in Figure 4, V, is a gaseous triode, such as a thyratron, supplied with a positive anode voltage through the primary winding of the output transformer, T, from the DC power source.

GRID IS POSITIVE

By means of the potentiometer, Rg, connected across the DC supply, a positive potential is applied to the thyratron grid. Rc is a cathode resistor and C its shunting capacitor.

Briefly, operation of the circuit is as follows: Direct-current flow takes place from the positive terminal of the DC power supply, through the output transformer primary, the tube, the capacitor, and to the negative terminal of the DC supply. It quickly charges the capacitor to a voltage equal to the DC supply voltage if the resistance of the transformer primary is low enough and Rc is high enough.

Still further, the primary inductance causes current to continue flowing beyond the instant when the capacitor is charged, eventually bringing the capacitor voltage up to a value higher than that of the DC supply before the flow finally ceases.

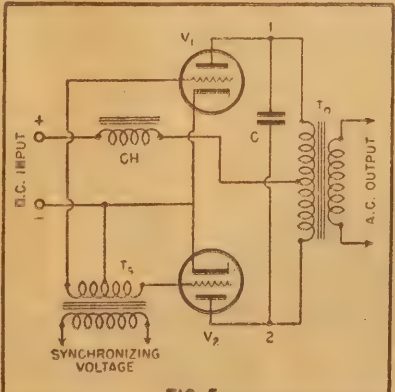
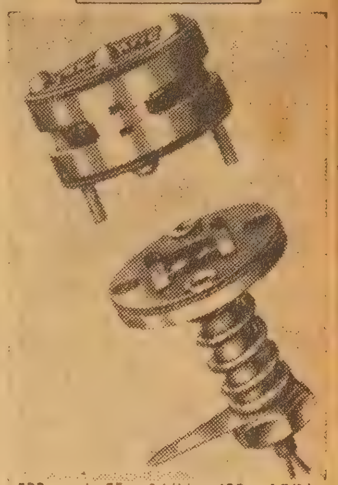


FIG. 5

The tube then ceases to conduct because, due to the high capacitor voltage, its anode has become more negative than its cathode by the amount of the final capacitor voltage.

Conduction cannot be resumed until the capacitor has discharged through the resistance, Rc sufficiently for the grid-cathode voltage to attain the critical value for the tube.

The net result is that current flows in the output transformer pri-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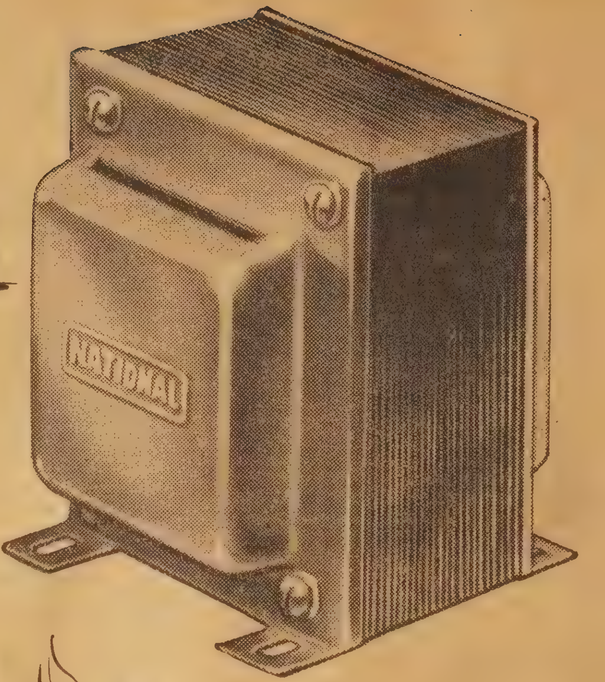

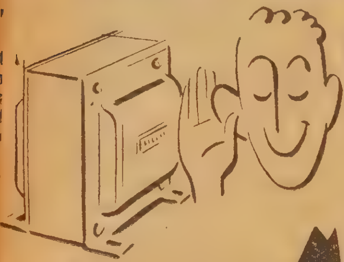

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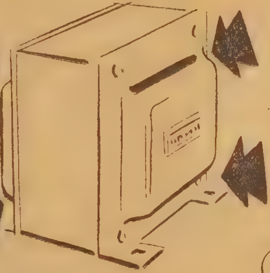

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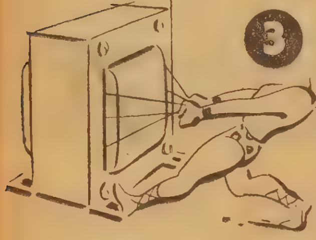
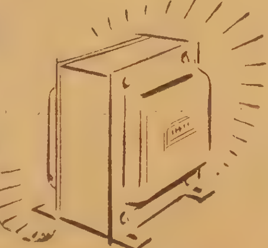


③ Special anchoring method prevents leads being pulled out.



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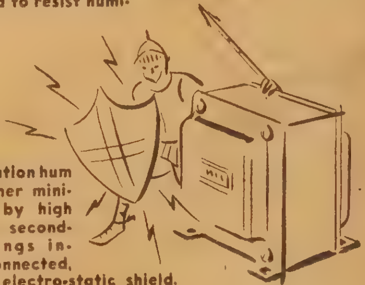

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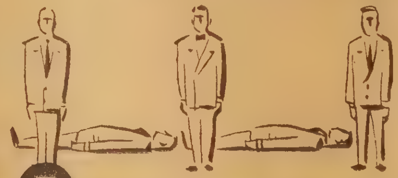

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mary in short pulses and that an induced alternating voltage appears across the secondary winding. The magnitude of this voltage, with respect to that of the DC supply, will be determined by the turns ratio of the output transformer.

The rate at which the tube and capacitor discharge and the DC pulses are sent through the transformer may be controlled by the potentiometer, Rg, and by the time constant of the Rc-C combination.

This will establish the frequency of the output voltage. However, a small synchronising voltage of the frequency at which output-voltage alternations are desired (or a multiple or submultiple thereof) may be applied to the thyratron and through the transformer, T.

SYNCH. VOLTAGE

This synchronising voltage might be generated by an oscillator, miniature alternator, buzzer, or similar AC source.

There are several single-tube inverter circuits in somewhat limited use, but push-pull inverters are more generally employed. Figure 5 shows one such two-tube arrangement.

This circuit embraces the two thyratrons, V1 and V2; a direct-current reactor, CH; a storage capacitor, C; the synchronising-voltage transformer, Ts; and the output transformer, To.

As in the single-tube arrangement, the tubes in this circuit perform a switching or commutating operation, and the capacitor, C, serves to supply power during the switching period.

In examining the action of the circuit, let us assume that both thyratron plates are positive and that the grid V1 has been made sufficiently positive by the excitation voltage introduced through Ts to initiate the discharge in that tube.

V1 will then be in a conducting condition and current will flow from the positive side of the input DC source through the upper half of the output transformer primary and back to the negative side of the DC source through V1. The grid of V2 is negative at this time and that tube is non-conducting.

OPERATION

The voltage drop developed across the transformer primary by the current flowing through its upper half charges the capacitor rendering point 1 negative and point 2 positive.

When the grid polarity reverses, no change is thereby occasioned in the conduction of current by the V1 plate circuit, the V1 grid having lost control; but the second thyratron, V2, becomes conducting, effectively connecting point 2 to the negative side of the DC line.

The result is that a momentary negative voltage is applied to the plate V1 and control is thereby restored to the plate of V1 and control is thereby restored to the V1 grid.

The action is repetitive and produces an alternating voltage in the windings of the output transformer.

The amount of current which can be drawn from the AC circuit is limited only by the capacity of the original DC supply and the limitations of the inverter valves.

Circuits of this nature have been devised capable of handling enormous amounts of current.

Naturally, the design of such equipment is very specialised and has little in common with radio engineering except perhaps in the basic principles.

In fact the same can be said of most industrial electronic devices. From being a mere offshoot of radio engineering, their design has become a specialised subject. The engineer practising in such fields must know enough of basic electronic theory for his purpose, plus an understanding of the industrial requirement, whether it be mechanical, chemical, aeronautic, or any other subject. (By courtesy of the Aerovox Corporation.)

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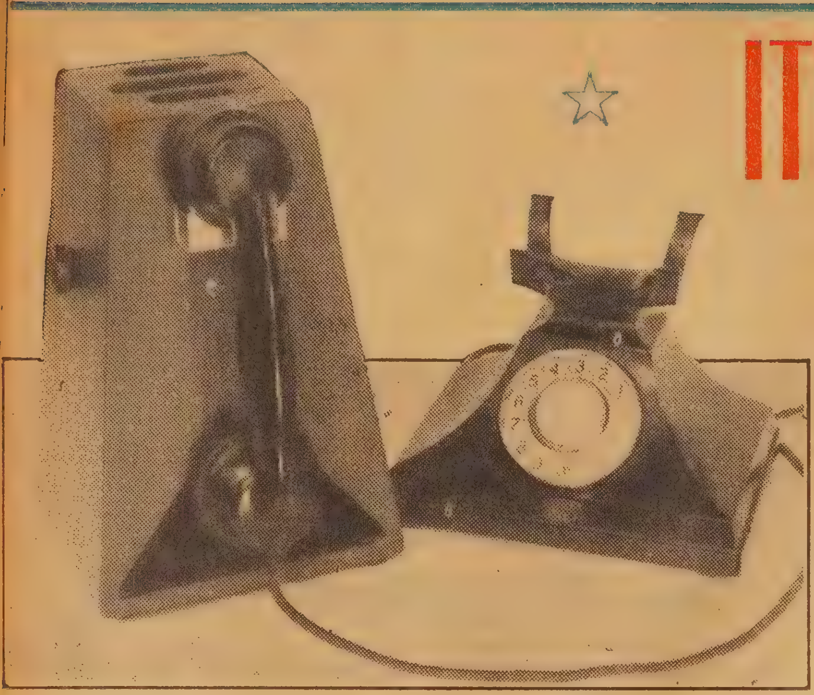

A picture of the complete unit in use with a standard handset telephone. The triangular opening at the bottom is the mouth of the horn and the fret at the top is the speaker opening. The knob on the left is the volume control. The unit is battery operated and completely self contained.

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by Philip Watson

PERHAPS the best way to start this article is to tell the story of how the unit first came into being. We would hasten to point out that the original idea was not our own, though we feel we can fairly take a large measure of credit for the present design.

From time to time the idea has been mentioned to us by a number of readers, one of whom went so far as to make up a workable unit. This reader was faced with the same problem that besets many business people—the amount of time wasted per day waiting on one end of a telephone while someone at the other end searches for the wanted party.

FAMILIAR PROBLEM

Anyone who has worked under similar conditions will readily appreciate the problem, the routine going something like this: You wish to ring Brown and Co. and speak to Mr. Smith, but the first couple of attempts to dial their number results in an engaged signal. (After all, Brown and Co. are a busy firm.)

Eventually, having already wasted much precious time, you succeed in making contact and ask for Mr. Smith. Then the fun starts. Mr. Smith is either engaged on another line, busy with a client, or just cannot be found for the moment. "He will probably be available in a few minutes," says the switch girl. "Will you wait on?" Remembering the difficulty you have already had getting this far, you decide to wait on.

The minutes drag by. There are many things which you could be doing while you wait, but with only one hand free you are practically incapacitated. You try to make a few notes about something you just remembered, but the paper slides all over the desk. You try to refer to a catalog but find it almost impossible to keep it open at the page you want. Eventually you resign yourself to sitting and waiting until Mr. Smith is available, which may render you immobile for up to 10 minutes.

By the time this procedure has been repeated several times a day it is quite easy to waste an hour or more, simply because one must hold the telephone to one's ear while waiting for someone to answer it. It is obvious enough that, if one could couple a simple amplifier to the phone to raise the incoming signal to loudspeaker level, it would be possible to monitor the circuit while continuing with other work.

From this thought was born the idea of a "telephone minder". After a practical test it became apparent that such a set-up was capable of working in both directions, at least under favorable conditions, due to the high sensitivity of the modern telephone transmitter.

By adding a simple horn, which would collect the sound more efficiently, it was possible to improve results enough for a "loudspeaking telephone" to become a real possibility.

The reader we mentioned earlier actually produced a unit built into a standard telephone base and which contained the speaker, amplifier, batteries and pickup coil for the receiving side, as well as the horn to couple to the transmitter.

Results were encouraging, but there were one or two minor problems which needed to be ironed out, and the idea was passed over to us to see what we could do with it. The result is pictured and described on these pages.

It is interesting to note also that an English firm has recently produced a commercial version of a similar device and that this is now being produced in the United States under licence to the English firm. Its introduction into the United States has been hailed as "the greatest telephone gimmick of all time".

Apart from its use as a telephone-minder, it is extremely valuable when notes have to be made from information received by phone, since it leaves both hands free while still providing talk-back facilities to permit checking. Similarly, when data have to be given over the phone, it is frequently necessary to refer to books or thumb through files, a process which can be extremely difficult with only one hand.

WHAT IT IS

A good idea of the device in its present form can be obtained from the photographs. It consists of a pyramid-shaped case occupying no more desk space than an ordinary telephone and which houses the amplifier, batteries, speaker, horn, &c., making the unit completely self-contained.

In use, the handset is simply hung on the front of the case, which action operates a simple gravity switch and turns on the amplifier. At the same time the handset rests in such a position that the receiver couples automatically to the pickup coil while the mouthpiece rests in the throat of the horn.

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- ***Leaves both hands for writing, &c.***
- ***Entirely self-contained —no power leads***
- ***No connections to the telephone circuit***
- ***Completely automatic in its operation***
- ***Relatively simple and cheap to construct***

Signals from the receiver will be heard through the loudspeaker in the top of the case while speech may be directed at the transmitter horn. The distance at which one may work from the transmitter depends on several factors, including the efficiency of the particular telephone channel, but it will usually be quite satisfactory up to 12 inches. This is quite enough to allow a note-pad or other data to occupy the desk between the operator and the instrument.

Under more favorable conditions greater distances may be possible.

FEEDBACK PROBLEM

There is one question which we know our more technically-minded readers are just itching to ask, namely, "What about feedback?" This is quite a reasonable query because, at first glance, it would appear that the set-up is a "sitter" for such a complication. The main reason for this is the fact that in any ordinary telephone circuit the one pair of wires carries the signals in both directions and the receiver in any telephone is therefore connected across its own transmitter.

For this reason there is always an echo of one's own voice in the receiver, as well as considerable pick-up of the general noise level in the vicinity. This is known in telephone parlance as "side tone" and it can cause serious interference to the distant signal when one's own phone is being operated in a noisy location.

In an effort to overcome this problem, PMG engineers developed what is known as an "anti-side tone circuit". This is an ingenious arrangement whereby the local receiver is effectively isolated from the local transmitter, though still in circuit as far as the distant transmitter is concerned. For various reasons the isolation is not made complete (though it could be), but is sufficient to improve performance considerably in noisy locations.

MAKES PROBLEM EASIER

What is more important as far as we are concerned is the fact that the possibility of feedback is reduced in direct proportion to the degree of isolation between the two halves of the circuit and, since most phones are now fitted with this circuitry, the problem is much easier than otherwise.

It must not be inferred that feedback will not take place, because it certainly will if the gain is high enough, but it does mean that, by careful placing of the speaker and horn, it is possible to operate the speaker at a perfectly satisfactory level without trouble.

So much, then, for the general considerations. Now let us consider the practical unit in detail. One of the main problems with the original design was that the handset rested in a horizontal position and that a carbon microphone is liable to perform poorly in such circumstances. Much depends on individual units, but there were many cases where performance was poor and was shown to be due to this fact.

For this reason we designed the unit to hold the handset in an upright position and, because there appears to be an even chance that a user will want to hang it on either the right or left-hand side, we hung it on the front. This also makes the design of the horn much simpler. Bringing the received sound out the top helps to isolate it from the horn, this being further assisted by the shelf holding the amplifier.

All the case dimensions are given in the drawing on page 63. A suggested addition is a small vent in the top back to relieve pressure from the speaker back wave.

Since it is an offence under PMG regulations to make any physical connection to the telephone circuit, connection to the receiver is made magnetically. There are many ways of doing this, and practically any iron-cored winding will provide some measure of pickup. However, a reasonably efficient system is desirable if the amplifier is to be kept simple.

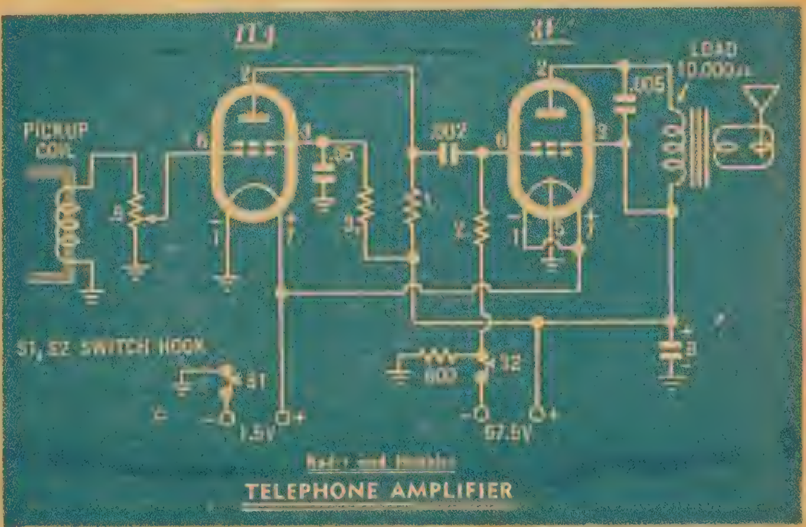
For our coil we used a pair of headphone bobbins similar to those mentioned in a recent article on tape head construction (Radio and Hobbies, November, 1953), and which are readily available through disposals. We understand that they are also available new from at least one manufacturer of telephone equipment and that another organisation is considering making them available, with the necessary core material, as a complete kit for this project. Each coil has a nominal resistance of 500 ohms.

STALLOY CORE

The core is made from a few pieces of stalloy such as can easily be obtained from a discarded transformer stack. Following the design of the tape heads, we bent two "U" shaped pieces, one slightly smaller than the other and designed to fit inside it, to form one half of the core. The coils are mounted side by side, one on each leg of the "U", and a strip of stalloy inserted in the opposite side of each to form the actual pick-up poles of the system.

The coils are mounted behind the front panel of the case and the pick-up poles of the core are brought out to the front through two narrow saw cuts in the panel. Since the centre of the handset receiver will not rest flat against the case, it is advisable to extend these legs to make the closest possible coupling with the receiver coils. This is best adjusted experimentally.

The ends of these poles should be turned over at the ends to form a



The amplifier is a straightforward battery design using two standard valve types and a few minor components. The plate by-pass is designed to compensate for the rather high pitched characteristic of the average telephone transmitter. Details of the pick-up coil are given in the text.

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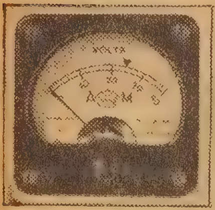

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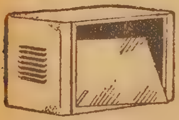

Receiver type, vented, with removable front panel as illustrated. Takes 8in x 5in chassis. Inside height 6in. Steel, black crinkle finish.
Part No. 4A12—31/6. Post Free.

SQUARE STEEL CASES
Square Corners, No Louvres

9in x 7in x 5½ in deep.	Part No. 4A2	20/6
7in x 5in x 4½in deep.	Part No. 4A3	18/6
5in x 5in x 4in deep.	Part No. 4A4	17/6

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PORTABLE 'GRAM CASES

Suitable for motor, pick up and amplifier (but not speaker). Strongly made of steel with black crinkle finish and hinged recessed lid. Size 20in x 12½in, height 8in. Lid including recess 4½in high. Space under lip for motor board 4¾in.
Part No. 4A5. Freight forward **75/-**

SPEAKER BOXES

12in particularly handsome case, tastefully covered in two-tone leatherette, strongly constructed of wood. Sloping-front type, suitable for portable public address system or good-looking extension speaker.
Part No. 4A6 . . . . **55/-**
Postage: Vic., 2/11; N.S.W., A.C.T., S.A., Tas., 4/4; Qld., W.A., N.T., 6/-

8in metal, round, suitable car radio or home extension speaker. Choice of green, cream, blue pastel finish. Post Free. Part No. 4A7. **22/6**

VALVES

We have the largest range of Valves in Australia. For any not listed here, use our Fast Quote Service.

CB1	23/9
CF1	25/6
CK1	26/6
CL4	24/3
CY1	23/9
CY31	23/9
EB4	24/9
EBL1	26/-
EBC3	24/9
EBL21	26/-
EBF35	22/9
EBF2	23/9
ECH3	25/-
ECH33	27/-
ECH34	25/-
EF6	25/6
EF36	23/-
EK32	26/-
EK2P	27/9
EL2	25/6
EL3N	26/-
EL32	25/6
EL33	20/9
EL35	28/6
EL50	28/6
EM4	18/9
EZ2/6X5	23/-
UBL1	27/9
UF9	23/2
UL41	24/9
UY1N	21/9
1941	17/6

RECORD PLAYERS and PICKUPS

BSR MONARCH 3-SPEED RECORD CHANGER, TURN-OVER CRYSTAL PICKUP. 10 Records Mixed.
Part No. 4A8. Freight Forward **£26/-/-**

BSR GU4C 3-Speed Record Player, turn-over crystal pickup. Part No. 4A9. Freight Forward **£13/15/-**

BSR MU14 Speed Motor Knob Control, complete with Turntable. Part No. 3N33. Including Postage **£7/-/-**

ACOS GP30 PICKUP. Turn-over crystal Head. Suitable for use with MU14 motor. Part No. 4A10. Including Postage **£4/19/6**

PRICE REDUCED!

GERMANIUM DIODES

Direct from England

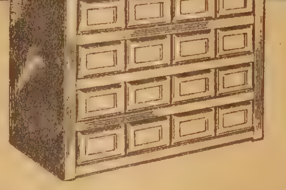
Type 4A 42 . . . . only

Special shipment just landed. Highest quality Germaniun diodes . . . positively the finest crystal detector available. Collins Radio are glad to be able to offer these up-to-date products at the new low price.

10/-

POST FREE

STOP!
FIND THOSE LITTLE THINGS FAST!

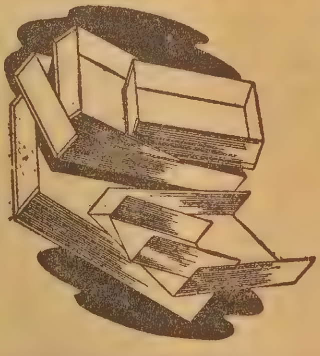


16 Drawers (1½" x 2 5/8" x 5½") IN THIS ALL-STEEL HANDY CABINET

A craftsman-built unit, attractively painted in baked enamel with provision for fitting identification card on each drawer.
A strong and most useful cabinet for holding small parts or tools, ideal for mechanic, engineer, garage, or home workshop.
Provision is made for stacking into units.
OVERALL SIZE 11¾in WIDE, 9in HIGH, 5½in DEEP **53/6**
Postage: Vic. 3/8; N.S.W., A.C.T., S.A., Tas. 6/-; Qld., W.A., N.T. 8/4.

ALUMINIUM CHASSIS —

Spot Welded ends



All Post Free

6 x 4 x 2	4A13	7/6
8 x 5 x 2½	4A14	10/-
10 x 6 x 2½	4A15	12/-
11 x 8 x 2	4A16	14/-
13 x 7 x 2½	4A17	14/-
13 x 10 x 2½	4A18	17/6
17 x 8 x 3	4A19	22/6
17 x 10 x 3	4A20	25/6
17 x 12 x 3	4A21	26/6

First grade aluminium, carefully turned corners, easy to drill or punch. Special sizes, 50 pc more.

FAST QUOTE SERVICE

For quickest possible service, write on the left-hand side of a sheet of paper the radio parts that interest you — one beneath the other. If a kit, itemise.
Add your name and address, and send it to us with a stamped, self-addressed envelope. We will add the latest prices and return to you. Use this sheet as your order and return to us with remittance for cost and postage as quoted. Goods will be sent same day. Any surplus refunded.

small flat about 1-8in wide. This provides a better coupling, particularly if there is a slight error in the line-up of the two units. However, avoid too fine a gap between these two poles, which will reduce efficiency. The poles are mounted horizontally, since this is the standard method of mounting in telephone receivers.

In our case, the top pole was mounted 7-8in from the top of the case (outside) and the spacing between the slots 7-16in. These figures are only given as a guide, and the position should be finally determined experimentally by removing the cover of the receiver and noting the position of the poles.

MU-METAL CORE

We tried mu-metal in place of the stalloy, and this does give slightly better results, but it is not essential and hardly worth chasing if it is not readily available.

A two-terminal tag strip is mounted alongside the coils, held in place with a countersunk screw through the side of the case. It provides a termination for the fine leads from the coils and from it runs a short length of shielded cable to the amplifier.

The coils should be connected in series aiding and this is achieved by connecting the two outside leads together and taking the two inside leads to the amplifier.

With the handset hanging on the front of the case the mouthpiece will be facing away from the user and speech pickup under these conditions is poor. The horn is, therefore, designed to collect the sound from the speaker, and turn it through 180 degrees into the mouthpiece, as well as increasing the area of sound pickup.

We conducted several experiments with various shapes to determine a suitable one and finally reached the conclusion that a simple design is practically as effective as a more complicated one.

SIMPLE FOLD

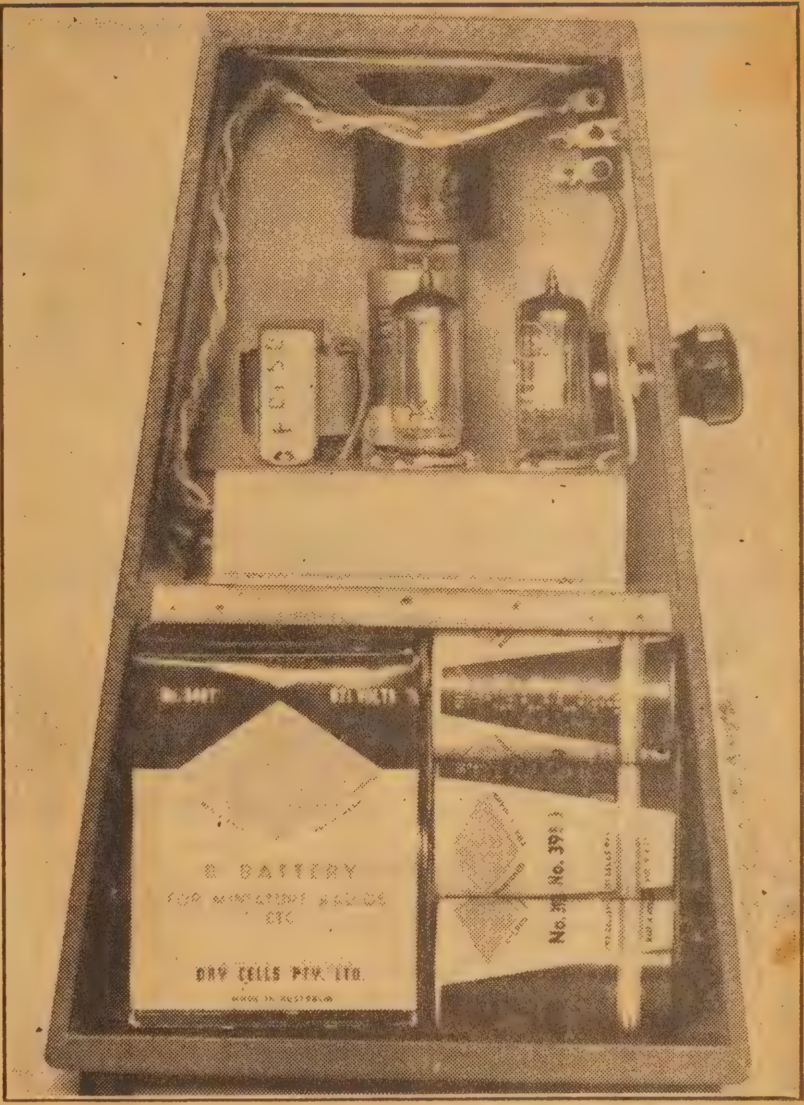
The final design consists of a simple eliptical fold with sloping sides, and a good idea of it can be obtained from the scale drawing on page 63. The original was made from 22-gauge tinplate and it should not be difficult for the home constructor to duplicate our effort by scaling up the drawing to full size.

If tinplate is not readily available in sheet form it should be possible to obtain enough material from a couple of discarded jam tins, or similar containers. All that is then required is a pair of tin snips and a soldering iron. When finshed it can be given a coat of black lacquer and its humble origin will never be suspected.

The horn is mounted against the front of the case behind the triangular cutout and is held in place by means of two 1-8in machine screws through the bottom near each front corner. This should force the top of the horn against the front of the case. The heads of the screws should be given a dab of black lacquer also, to match the horn.

A battery-operated amplifier was selected almost automatically. The power available is quite adequate for applications of this kind, and the intermittent nature of the operation

VIEW WITH REAR LID RAISED



This rear view gives an excellent idea of the complete layout. At the top of the case is the speaker and near it the tag strip and shielded cable connecting the pickup coil to the amplifier. The pickup coil is hidden by the speaker. The shelf supporting the amplifier also serves to isolate the speaker from the transmitter.

PARTS LIST

1 Case (See diagrams page 63)
1 Chassis 4in x 2½in x 1in
1 3in permag speaker
1 3V4 valve
1 1T4 valve
2 7pin miniature valve sockets
1 3 meg ½w resistor
1 2 meg ½w resistor
1 1 meg ½w resistor
1 .5 meg potentiometer
1 600 ohm 1w resistor
1 8 mfd electrolytic capacitor (chassis mounting)
1 .05 mfd paper capacitor
1 .005 mfd mica capacitor
1 .002 mfd mica capacitor
1 10,000 ohm output transformer (FCL 58 or similar)
1 600 type relay, 2 normally open contacts, complete with yoke and armature but minus coil (see text)
2 5-terminal tag strips
1 2-terminal tag strip
2 500 ohm headphone bobbins (see text)
Strips of stalloy for pole pieces
3 950 cells
1 467 battery
Fastener terminals for battery, hook-up wire, nuts, bolts, tinplate for horn, etc.

Striped Canvas

Green and White, 72in wide. Ideal for verandahs, awnings, covers, etc.

8/9 Yard

Please add postage.

LEAN-TO AUTO TENTS

Heavy proofed duck top, with duck walls. Brand new. Complete with Rope, Poles, etc.

Sizes	Walls 6ft x 4ft	Walls 7ft x 5ft
12ft x 9ft	£13/8/6	£14/13/3
15ft x 9ft	£16/1/6	£17/18/9

Easy to handle and quickly erected. Freight payable at nearest attended railway station.

3-ROOM MARQUEE, 18 x 12

12oz and 15oz BRITISH PROOFED DUCK TAILORED TOP WITH 8oz. 6ft. DUCK WALLS. COMPLETE WITH ROPE, POLES, ETC.

BARGAIN PRICES

12oz.	15oz.
£39/2/-	£48/10/-

Complete with Dividing Walls and all Fittings. Freight payable at nearest attended railway station on all marquees and tarps.

HIKERS' TENTS

Size 6ft. x 4ft. x 4ft.

PLAIN LIGHTWEIGHT Each **53/6**

Postage, 3/11; Interstate, 5/4

Special Disposal Clearances

RANGEFINDERS. Aircraft bubble. Cost £40	37/6
COMPASS. Aircraft Liquid filled. Cost £27	55/-
FUEL GAUGES. New	3/6
CALCULATORS. Course and speed. Suitable car trials, etc.	7/6
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PLOTTERS	1/6
ALTIMETERS. Cost £20.	£2/10/-
MOTORS, 50V 50 Cycl. New	£2/10/-
PRISMS. Periscope. Cost £5.	4/6
SCALES. Single Brass	2/6
VICKERS Sights with Level. Incomplete.	7/6

PLEASE ADD POSTAGE.

DUNGAREES

NAVY DENIM

39/6 pair

Post: 2/1; Int., 3/3.

KHAKI SHORTS

Extended Waistband 30-40 Waist

16/11 pair

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TARPAULINS

12oz. and 14oz. GREEN BRITISH PROOFED DUCK TARPAULINS.

All brand new.

12oz.		14oz.	
6 x 8	£2/14/6	6 x 8	£3/5/9
8 x 10	£4/9/1	8 x 10	£5/7/3
10 x 12	£6/13/8	10 x 12	£8/1/3
12 x 15	£10/2/11	12 x 15	£12/5/-
12 x 18	£12/3/3	12 x 18	£14/14/9
15 x 18	£15/4/4	15 x 18	£18/7/6
20 x 15	£16/16/6	20 x 15	£20/9/-
18 x 24	£24/6/5	18 x 24	£29/8/4

Freight payable to nearest attended R'way St.

GERMAN FIELD GLASSES

BRAND NEW

Light weight centre focus with Special Eye Width Adjustment. Unbeatable value.

ONLY 35/- PAIR

Post: NSW, 2/1; Int., 3/3.

DEITCH BROS.

MARQUEES

BRAND NEW

SPECIAL

12 and 15oz. British Proofed Duck, Tailored Top with 8oz. 6ft Duck Walls. Complete with Ropes, Poles, etc.

	12oz.	15oz.
10 x 10	£22/7/6	£28/9/-
12 x 12	£26/2/-	£33/15/6
15 x 15	£33/16/-	£44/4/6

SPECIAL! COTTAGE TENTS

PLAIN ROOF, 6 x 8 — — £4/19/- ea.

Or WITH 12oz. and 15oz. BRITISH PROOFED DUCK Tailored Roof. No Fly Necessary.

	12oz.	15oz.
6 x 8	£7/7/6	£11/4/6
8 x 10	£9/17/9	£15/5/-
10 x 12	£12/12/9	£19/13/6

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£10 TOOL OFFER

Special selection of quality spanners—all brand new in following sizes:—Set of 6 double-ended Ring Spanners S.A.E., 3/8 x 7/16, ½ x 9/16, 11/16 x 5/8, 25/32 x ¾, 13/16 x 7/8, 15/16 x 1. Set of 6 Set Spanners S.A.E., ¼ x 5/16, 3/8 x 7/16, ½ x 9/16, 5/8 x 11/16, ¾ x 7/8, 15/16, 1. Whitworth set spanners 1/8 x 3/16, ¼ x 5/16, 3/8 x 5/16, ½ x 7/16, 5/8 x 9/16. Set of Three Tappet Spanners — 7/16 to 11/16 S.A.E. One 6in Shifting Spanner, one 8in Shifting Spanner. One pr. 7in Insulated Pliers. One pr. 6in Nippers. One Metal Tool Box—14in x 7in x 4in.

THE LOT - - - - - - - - - £10

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SORRY, NO C.O.D.

DEITCH BROS.

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70 OXFORD ST, SYDNEY.
(BETWEEN CROWN AND RILEY STREETS.)

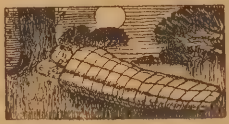
CAR COVERS

SPECIAL FINE-WEAVE COVERS

12 x 15	£3/9/6
18 x 12	£4/3/6
18 x 15	£5/3/-
20 x 15	£5/13/6

Post 5/8; Int., 5/-.

SLEEPING BAGS



Wool filled	£3/15/-
Feather filled	£6/17/6
Feather filled with hood	£7/7/9
Super Down filled with hood	£8/6/9

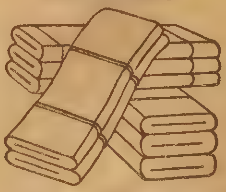
Post: NSW, 3/11; Int., 5/4.

BOOTS

Strong Work Boots	33/9 pr.
Officer Type	39/6 pr.
Ex-Army Type	44/6 pr.
Riding Boots, elastic sides	39/6 pr.

All Sizes. Post 3/2, Int., 4/7.

SHEETS



LARGE DOUBLE BED
90 x 100 — A1 Quality
5 years' wear in every pair.

£3/15/- pair.

Post N.S.W. 4/8; Interstate 7/-

UNBLEACHED SHEETING

54in SUPER QUALITY .. .. **3/11yd.**

or 20 yards £3/15/-.
Post 5/8; Int., 9/-

CALICO

36in. wide. **2/6yd.**

Add Postage
30yd. Roll £3/10/-.
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Calico Flour Bags Unbranded

Super Quality unbleached Calico 50lb Flour Bags.

18/- per doz

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Painters' DROP SHEETS

Brand new. 15ft x 6ft
Also suitable for blinds.

Price 35/-

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OIL PAINT

OIL-BASE PAINT.

EVERY GALLON GUARANTEED. Cream, White, Red, Roofing Red, Light Stone, Mid Stone, Dark Stone, Green, Grey, Chocolate.

2-Gallon Drum 55/-

SPECIAL PRICE

4-GALL. DRUM

£4/19/6

SAVE £3

Please add 2/6 per drum cartage to rail; freight payable at your nearest attended Railway Station.

is ideally suited to battery life. The amplifier need only operate when actually in use, thus prolonging valve life, while the elimination of connecting leads and power points is a big advantage.

The circuit is quite straightforward being a simple two stage resistance coupled unit. Power is provided by a miniature 67.5 volt battery and a 1.5-volt battery consisting of three type 950 cells in parallel. A single cell will work quite well, but replacements will be less frequent with the larger battery.

67.5 volts appears to be adequate for all ordinary purposes, though the case will accommodate a miniature 90-volt battery if desired. This will increase the power output as well as improving the sensitivity slightly. However, in most cases this will not be necessary.

MORE GAIN

For our initial experiments we used a 1S5 and 3V4, and this worked quite well, but we found that we could get slightly more gain by using the 1T4 in place of the 1S5. The difference is not staggering and would not justify buying a 1T4 if a 1S5 was already available. However, if all new components are being used the higher gain valve should be selected.

The amplifier is mounted on a small chassis measuring 4in x 2½in x 1in. As can be seen from the photographs a section is bent up to form a bracket for the volume control. This is set at a slight angle to suit the angle of the case.

Above the chassis are mounted the major components, valves, pots, 8 mfd capacitor, and output transformer. The 8 mfd needs to be of the chassis mounting variety for this position but a pigtail type may be used if necessary, there being room under the chassis to accommodate it.

There are only a handful of components underneath the chassis and most of them can be supported on the valve socket lugs. However, two tag strips are used, one to mount the 600 ohm bias resistor and the other to terminate the battery and speaker leads. Both are the five terminal type and their position may be seen in the photograph. Don't forget to earth the central spigots on the valve sockets.

NEGATIVE SIDE

There is one small point regarding the "ON-OFF" switch which is worthy of comment. It will be seen from the circuit that the negative side of both the high and low-tension circuits is broken rather than the positive side, as is usual. The reason for this is to minimise risk of valve filament overload in the event of breakdown between the high and low tension switch contacts.

This is not very likely in the normal way but becomes a real possibility where various makeshift or junk box arrangements are employed in the construction of the switch hook. Even in the arrangement we used it would not be impossible for these two circuits to become mixed up and we decided that this small modification would provide an additional safety margin.

There are many possible arrangements for the actual switch hook and the reader with a well stocked junk box and a little ingenuity will probably be able to evolve a scheme to suit his own requirements. However, the scheme which we have worked out appears to be as good as any and has the advantage of using standard components which, while not usually available from a radio dealer's shelf, can be obtained on special order.

We found it most satisfactory to provide a rigid bracket to take the weight of the handset, thus ensuring that it always rests in the correct position relative to the horn. This consists of a "U" shaped bracket, approximately ¾in on all three sides, and 2in long. One side, which mounts against the front of the case, is cut out to allow the arm of the switch hook to pass through to a point where it will be operated by the lower edge of the receiver case.

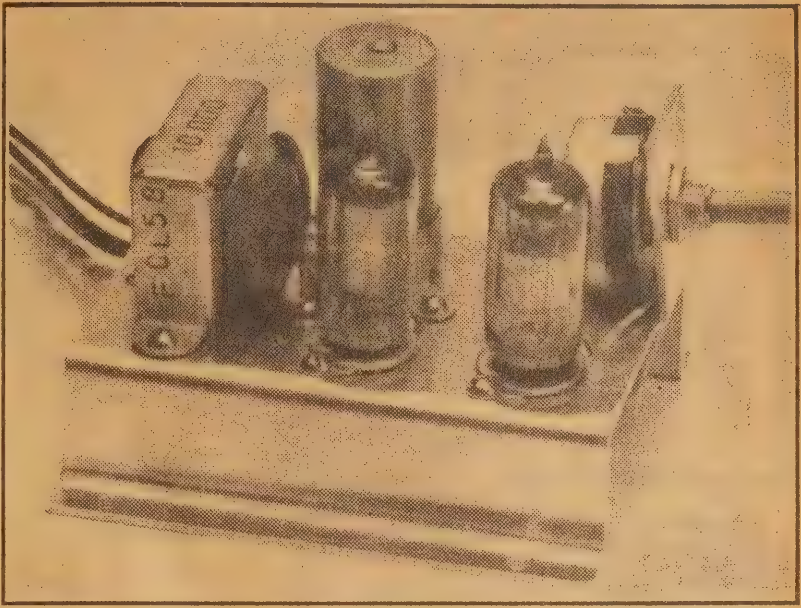
The opposite side has a curved cutout to suit the curve of the handset and a good idea of the arrangement can be obtained from the photograph of the finished unit. The details of the bracket will be included in the chassis blueprint and should be available ready made along with the chassis.

For the switch hook proper we required an assembly of contacts which

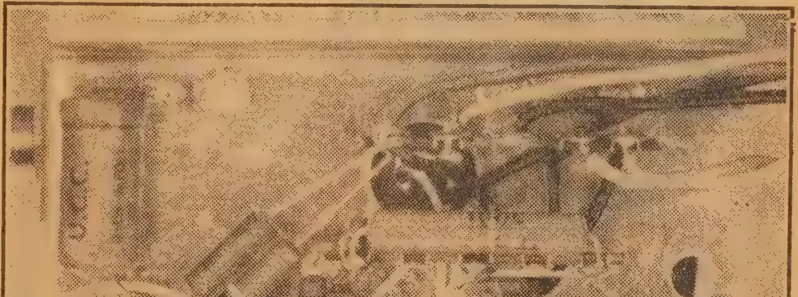
(Continued on Page 65)

See plans overleaf ☞

TWO VIEWS OF THE AMPLIFIER



A top view of the amplifier showing the major components. On the right is the IT4 with the volume control behind it. Centre is the 3V4 with the 8 mfd capacitor behind it. The output transformer is on the extreme left.



An underside view of the amplifier chassis. When this picture was taken we were using a 1S5 as an amplifier valve, this being subsequently changed to a 1T4 to obtain slightly higher gain. The 3V4 socket is on the right and above it the tag strips for battery leads and bias resistor.

This design ensures . . .

SPECIFICATIONS

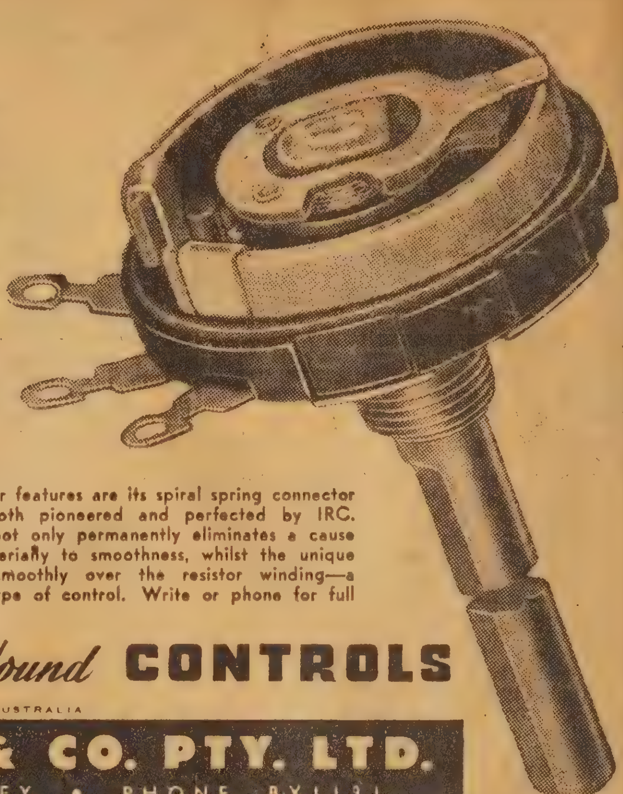
Resistance Values. Available in all standard values between 5 ohms and 10,000 ohms, 2 watt rating.

Wattage in rotation. Mechanical rotation 295°. Electrical rotation 266°.

All shafts are insulated. Maximum operating voltage from any terminal to ground is 900 volts RMS at standard atmospheric conditions.

Dimensions. Diameter, 1¼ in. Depth from mounting face, 9/16 in. Shafts, ¼in. dia., ⅜in. bushing. Standard shaft length, 2¼in., from front plate to end of spindle.

PERMANENT NOISE-FREE OPERATION



The IRC Type W Wire Wound Control is a compact low power unit, possessing excellent mechanical and electrical characteristics, designed for long, dependable service.

Chief among its many superior features are its spiral spring connector and its unique contactor—both pioneered and perfected by IRC. The spiral spring connector not only permanently eliminates a cause of noise but contributes materially to smoothness, whilst the unique contactor assembly moves smoothly over the resistor winding—a feature so essential in this type of control. Write or phone for full details.

IRC AUSTRALIA

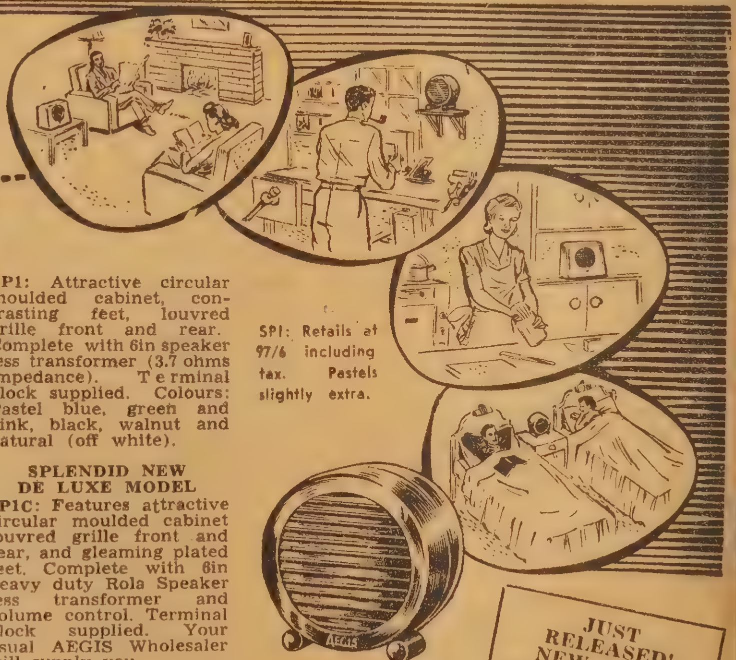
TYPE W *Wire Wound* CONTROLS

SOLE AGENTS FOR AUSTRALIA

Wm. J. McLELLAN & CO. PTY. LTD.
126 SUSSEX STREET, SYDNEY • PHONE BX1131
(50 yards north of King Street)

AEGIS EXTENSION SPEAKERS PROVE THAT . .

"It costs so little to enjoy RADIO in any room!"



The new Aegis Extension Speakers are the latest means of enjoying radio in every room. You can choose many attractive colors that blend pleasantly with modern and period furniture. There are Aegis distributors in all States . . . so ask to see the new Aegis Extension Speakers at your Aegis dealer's store.

SP1: Attractive circular moulded cabinet, contrasting feet, louvred grille front and rear. Complete with 6in speaker less transformer (3.7 ohms impedance). Terminal block supplied. Colours: Pastel blue, green and pink, black, walnut and natural (off white).

SP1: Retails at 97/6 including tax. Pastels slightly extra.

SPLENDID NEW DE LUXE MODEL

SP1C: Features attractive circular moulded cabinet louvred grille front and rear, and gleaming plated feet. Complete with 6in heavy duty Rola Speaker less transformer and volume control. Terminal block supplied. Your usual AEGIS Wholesaler will supply you.

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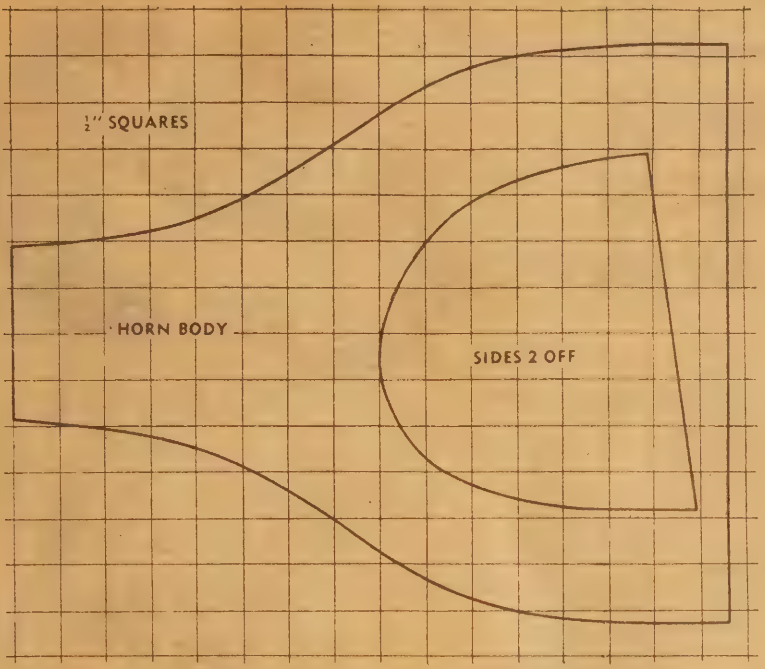
Special Remote Control Box 68/3

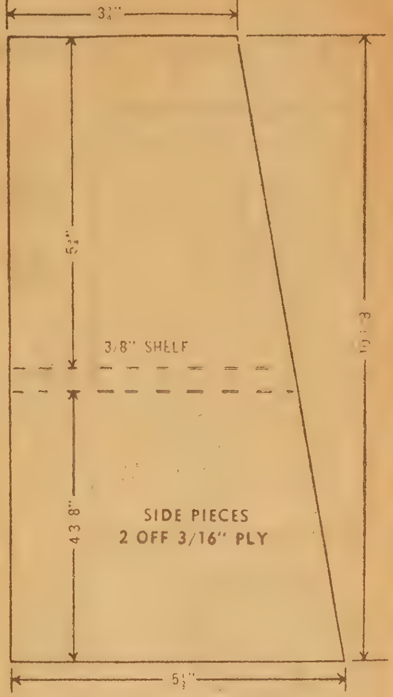
JUST RELEASED! NEW AEGIS JUNIOR 6-INCH EXTENSION SPEAKER
In moulded plastic cabinet—a replica of SP1.
RETAILS AT ONLY
50/-

AEGIS

THE NEW AEGIS EXTENSION SPEAKERS

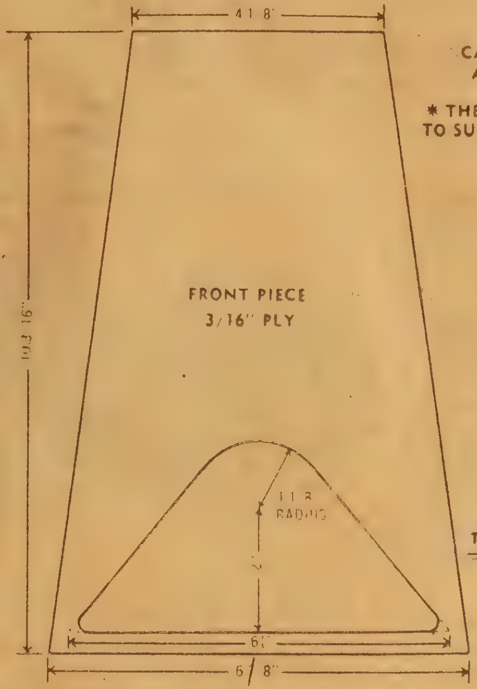
AEGIS MFG. CO. PTY. LTD., 208 LITTLE LONSDALE STREET, MELBOURNE, FB3731.

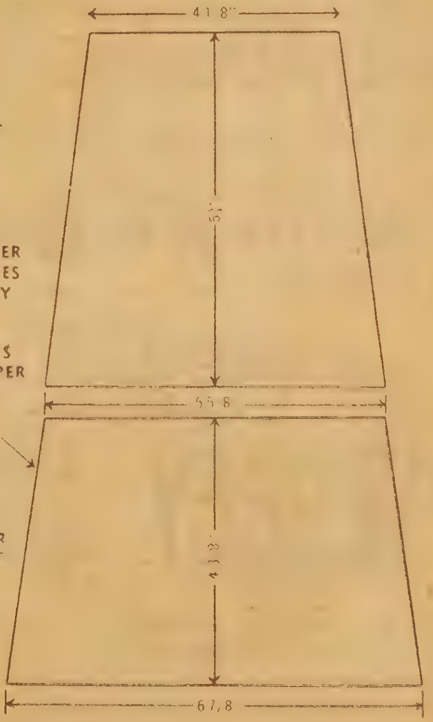

1/2" SQUARES
HORN BODY
SIDES 2 OFF


3¼"
5¾"
3/8" SHELF
4 3/8"
10 1/8
SIDE PIECES
2 OFF 3/16" PLY
5½"

CABINET DETAILS
ARE 1/3 SCALE

* THESE EDGES ANGLED
TO SUIT TAPER OF CABINET

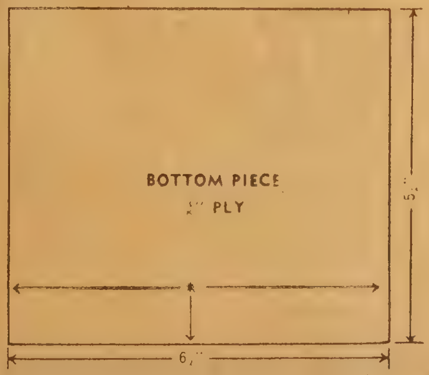

4 1/8"
10 3/16"
FRONT PIECE
3/16" PLY
1 1/8
RADIUS
2"
6¼"
6 7/8"

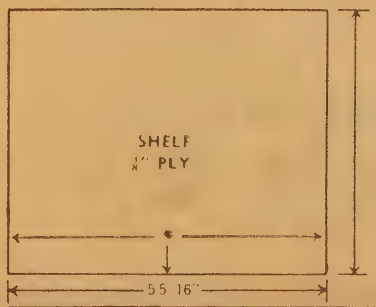

4 1/8"
5½"
5 5/8
4 3/8"
6 7/8

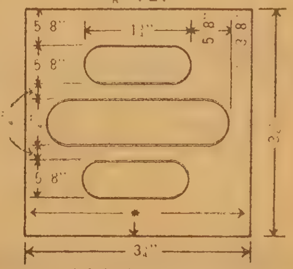
BACK COVER
TWO PIECES
3/16" PLY

HINGE THIS
PIECE TO UPPER
COVER

RADIO AND HOBBIES
TELEPHONE AMPLIFIER


BOTTOM PIECE
3/8" PLY
5¼
*
6¼"


SHELF
3/8" PLY
*
5 5/16"


TOP PIECE
3/8" PLY
5/8"
1¾"
5/8"
3/8
5/8"
5/8"
3¼
*
3¼"

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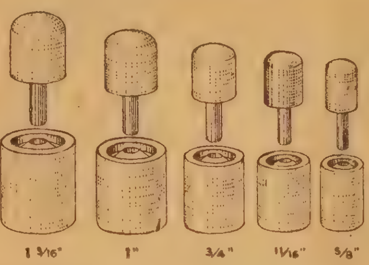

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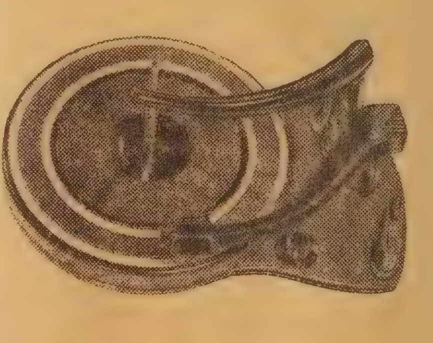

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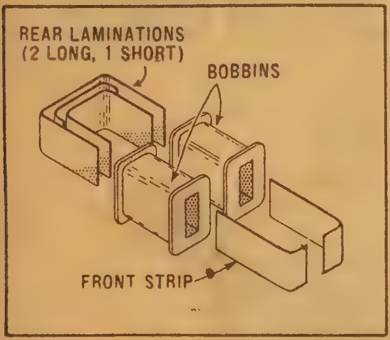
could be mounted against the inside front of the case and which could be operated by the vertical movement of the handset.

The requirement was so similar to a standard relay movement that we contacted a leading relay manufacturer and asked him if he could supply a relay movement having the necessary contacts but minus the coil. Not only was he able to supply us but he expressed his willingness to supply similar units to the trade to meet the requirements of home builders.

The exact details are as follows: One only 600 type relay with two sets of contacts, each normally open, and complete with armature and yoke, but minus a coil.



The assembly of the coils and core strips is similar to that employed in tape head construction, the main difference being the nature of the "gap". Note that the core strips will be mounted horizontally to match the standard mounting of telephone receiver coils.

The 600-type relay is rather smaller than the better-known type 3000 and has been available through disposals stocks. It is likely that many readers will have suitable types on hand. To adapt it for this purpose the coil should be removed and the shorter arm of the yoke, which previously held the coil, cut off. This allows the longer arm of the yoke, holding the contact assemblies and the armature, to mount flat against the inside front of the case.

A slot must now be cut in the case to allow the armature to protrude through the cut-out in the rear of the U-shaped bracket. The position of this cut-out should be determined with care. For our unit, the top of the slot was 2 1-8in from the top of the case (outside). It is ¼in deep and 5-8in wide.

CUTTING THE SLOT

Before cutting the slot, the leatherette covering should be cut with a sharp razor blade on a horizontal line along the centre of the proposed slot. Short vertical cuts at each end should now be made, and this will allow two small pieces of the covering to be peeled back while the slot is made. It is most easily cut out with a coping saw and finished off with a file. The leatherette is then glued back into place and the surplus turned into the slot.

Because of the angle of the case front, the armature does not protrude through the slot at quite the angle required, and we found it necessary to make a further modification. This takes the form of an extension to the armature consisting of a piece of sheet metal approximately ¼in x ½in which is fastened to the back of the armature.

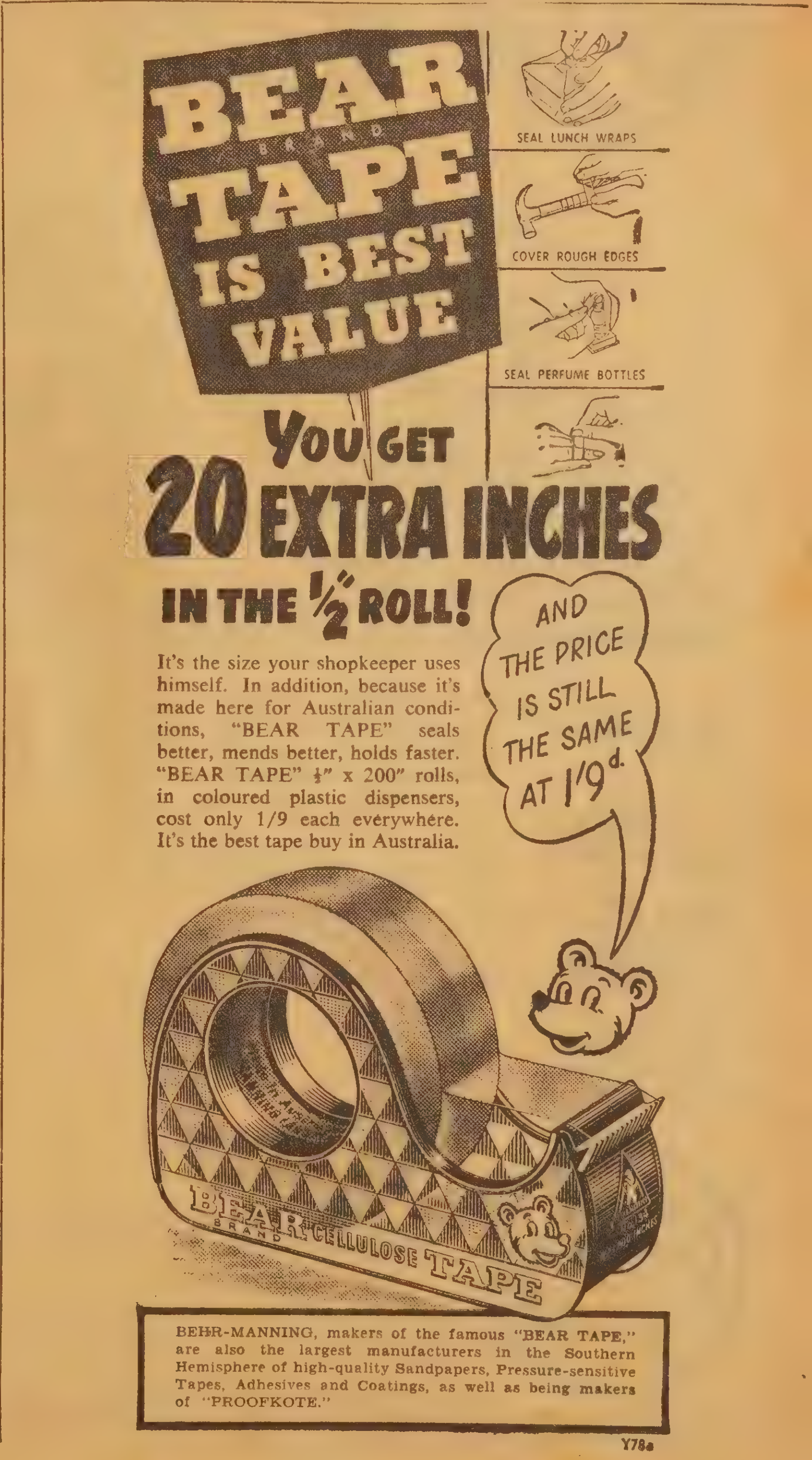
By punching out the small copper slug in the armature, a hole is provided by which this attachment can be made. A rivet is the best means of fastening, plus some solder for added stability.

The protruding portion of the attachment may now be bent slightly downwards so that it presents the correct angle to the receiver case. In our unit we found it best to space the relay away from the inside front of the case by 3-16in. A strip of 3-16in ply provided the necessary spacing.

The relay was mounted to the case by means of two 1-8in machine screws, appropriate holes having been drilled and tapped in the yoke. One of the mounting screws can be seen in the photograph.

It is likely that the terminals on the contact assembly will be too long to avoid fouling the amplifier shelf. It would be possible to provide a cut-out in the shelf to accommodate these, but this may allow unwanted sound to be directed towards the transmitter. We found it a simple matter to cut the terminals off flush

(Continued on Page 105)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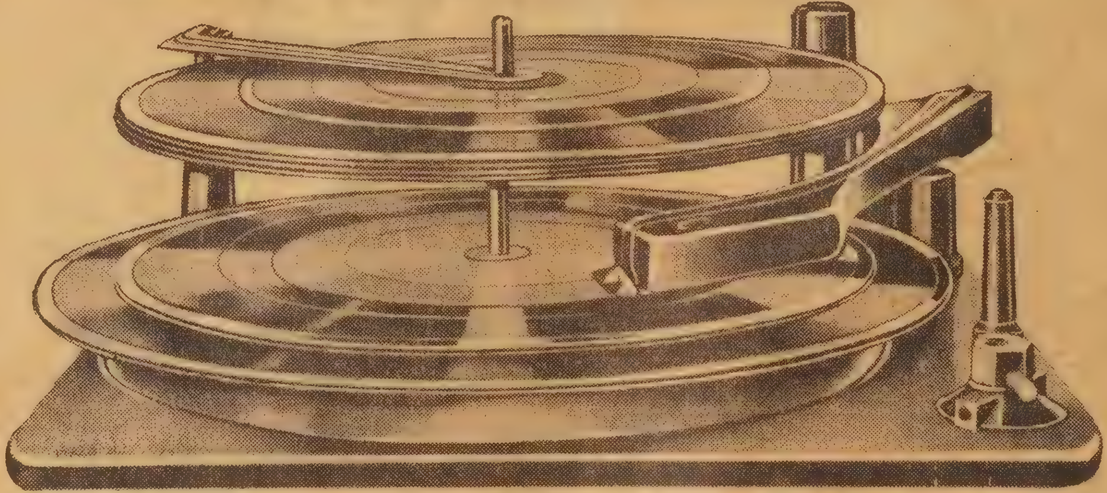

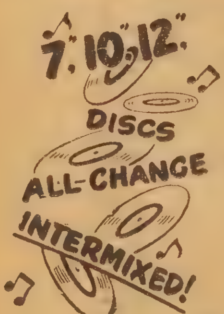

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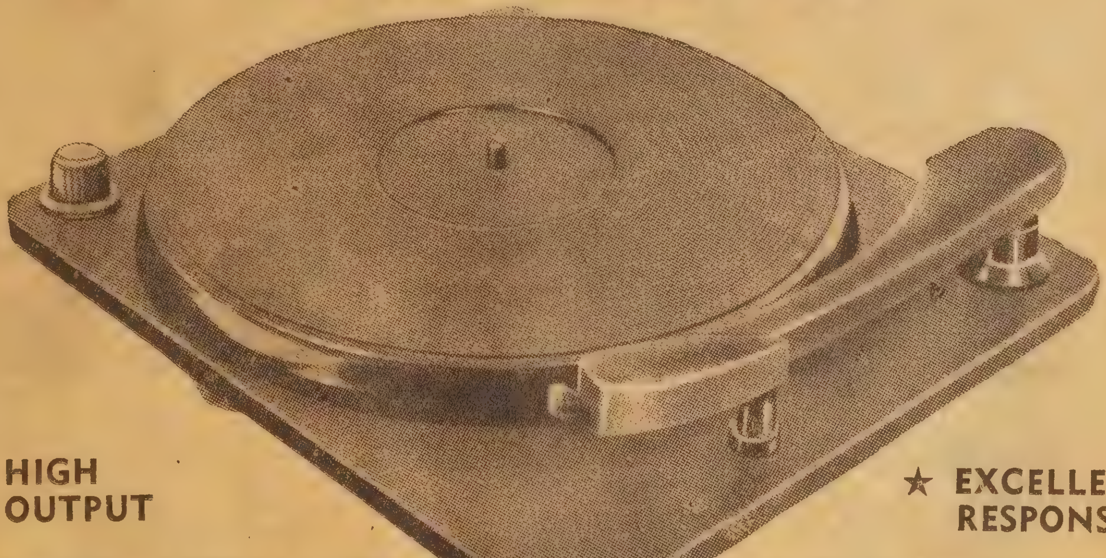

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Here's your answer, Tom!

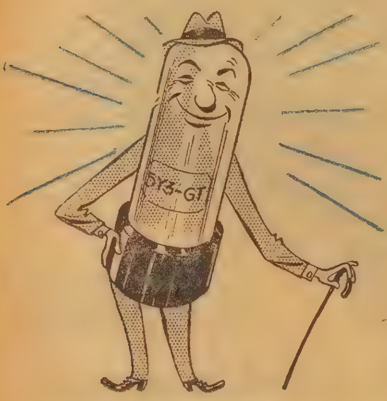
Tom's questions this month give us an opportunity to clear up a number of technical points on a variety of subjects which, after all is our main purpose in life. Our artist doesn't miss the chance to take a sly dig at Tom about a couple of queries but we know it will be taken in a spirit of goodwill as intended.

THE first question and its answers may help to correct a common fallacy about component ratings

I have a power transformer which is rated at 385 volts at 40 mA. What would be the effect if this were used with a 5Y3-GT, the plate current of which I believe is 125 mA? Would the secondary heat up or be destroyed or would the output current be limited to 40 mA?

The 5Y3-GT is an amiable character, Tom, quite willing to do his best under the circumstances. You have represented him as a greedy fellow, taking all he requires, regardless of the feelings of others.

The ratings on the valve and power transformers are the maximum that can be delivered without overload. If the full output is not required, they will work along quite happily delivering less. If the power transformer and valve you have are used together, the maximum current that can be drawn from the combination without overload is 40 mA.



An amiable fellow . . .

If you try to take more than 40 mA, the power transformer will get hotter than the manufacturers consider safe. If operated continuously at 125 mA, there is every chance that it would burn out.

The same applies to the valve. If operated outside its ratings it will overheat and possibly be permanently damaged.

To sum up, you can draw a current of from zero to 40 mA from your power supply. The output voltage will depend to some extent on the current because of the internal resistance of the transformer and valve. With zero drain and capacitor input filter, it will be over 500 volts. With a current drain of 40 mA it will be about 450 volts.

Most receivers require 250 volts high tension. It would, therefore, be necessary to include a dropping resistor. The value can be worked out quite simply from Ohm's law. For example, if the supply is 450 volts and 250 volts at 40 mA is required, the voltage across the dropping resistor will be 200. Dividing the voltage by the current (expressed in amps) gives the required resistance. In this case it is 5000 ohms.

Could you also explain what is meant by the terms "peak inverse voltage" and "peak plate current"?

In the valve books, Tom, the peak inverse plate voltage is defined as the maximum instantaneous plate voltage in the direction opposite to that in which the valve is designed to pass current.

If you study the operation of a rectifier valve operating from an alternating current supply, you will realise that such a rating is necessary.

Considering a simple half-wave rectifier for a start. The voltage applied to the plate starts from zero and increases in a positive direction until it reaches a peak after which it returns to zero again.

CURRENT PULSES

Current will flow through the valve during some or all of the time that the positive voltage is applied to the plate. If the valve is feeding into a filter with a capacitor input, there will probably still be some voltage across the capacitor so that the valve will not begin to conduct until the plate voltage exceeds the capacitor voltage.

If no current is drawn from the filter the capacitor will charge to the peak voltage appearing at the plate and, discounting losses due to leakage, remain charged at this value.

The voltage applied to the plate follows the sine curve, however, and having reached zero begins to increase in a negative direction until it reaches a peak of the same value as in the positive direction.

At this instant, if there is no current drawn from the input capacitor, the voltage between plate and cathode of the valve is twice the peak in any one direction. For a 385-volt supply, this would be nearly 1100 volts. The 5Y3-GT has a peak inverse plate voltage rating of 1400 volts, so that it would be quite okay in this case.

In the above calculations note that the peak voltage is approx. 1.4 times the RMS voltage which is the value usually quoted.

The peak plate current is the maximum instantaneous plate current passing recurrently through the valve in the direction of normal current flow, according to the definition given by the manufacturers. This peak current flows when the instantaneous positive plate voltage applied to the valve is at its maximum. Its value depends not only on the internal resistance of the valve itself, but on the resistance of the rest of the circuit and the value of the input capacitor.

The peak plate current may be many times the average current. For example in the case of the 5Y3-GT the maximum average plate current is 125 mA, while the maximum peak plate current is 400 mA.

I would like to know if there is a simple means of finding the value of condensers. I have several fixed condensers the values of which have been rubbed off. Is it possible to find their correct value without using specialised equipment?

"Squeeging" or "Squegging"

We are afraid not, Tom. The capacitors sound like small paper or mica types used in radio receivers. About the simplest satisfactory method of measuring their value involves a special bridge circuit, with an alternating current supply. Unless you are doing a good deal of experimental work it would not be worth your while building one.

The cheapest way out of the problem at the moment would be to take the capacitors along to a serviceman with a suitable bridge. With the correct instrument it's only a few seconds' work to determine their values.

I have noticed that a number of modern radios lose their volume on shortwave only after about 12 months' operation. Could you explain the reason?

That is a hard question to pin down to definite terms, Tom. However, we would suggest that the gain on the broadcast band has also decreased, but there is such a big reserve that it is not noticed. This could be caused by slight detuning of intermediate frequency transformers and slight variations in the values of resistors throughout the set.

It is unlikely that the shortwave section only of the receiver would become detuned as the high frequency circuits tend to be less critical than the low frequency circuits.

OSCILLATORS

How is an oscillator using a pentode valve able to modulate its own generated signal by "squeeging", and what exactly is squeeging?

You seem to have mixed your hobbies a little, Tom. Don't make the mistake of dunking your latest five-valve receiver in the developer. You may find that all you will develop will be a crop of troubles.

A squeegee is a rubber roller for removing the excess water from photographic prints. We admit that it's easy to get mixed up, but the correct way to spell the word is "squegging".

When the oscillator is operated with a grid leak resistor, which is high in value, the bias developed across the resistor becomes greater and greater until eventually it is so high that the oscillation ceases altogether. The time it takes to do this is dependent on the value of the coupling capacitor as well as the resistance.

As soon as oscillation ceases, the charge on the capacitor begins to leak away until it eventually reaches a state where the oscillator is able to function again. The time taken for this to happen also depends on the values of the coupling capacitor and grid leak resistor.

REPEATS PROCESS

The blocking voltage at the grid of the valve increases as soon as oscillation starts again and so the whole process repeats itself. The time taken for the building up and the decay can be varied by varying the values of the grid leak resistor and the coupling capacitor, hence the frequency can be varied in the same way.

When an oscillator operates at a particular frequency and goes in and out of oscillation regularly at a lower frequency, it is said to be squeeging.

The squeeging can be made to occur at an audio rate in which case the oscillator would be useful for aligning receivers with the aid of an audio output meter. The same basic idea is used in the superregenerative receiver for VHF and UHF reception. Tremendous amplifications are achieved in a single detector valve which is made to superregenerate at a frequency in the order of 100 Kc.

This type of receiver has the disadvantages that it tends to radiate if coupled directly to an aerial and also that the selectivity is very poor.

However, most of the amateurs operating of the VHF bands have had cause to make use of the circuit at one time or other because of its simplicity.

A reader from Lakemba, NSW, has two parcels of valves which he is prepared to give to a couple of young Radio and Hobbies' readers, keen on radio, but not earning wages to buy parts of their own. His address: Mr. E. Hough, 1 Berring Av., Lakemba, NSW.

I would like to know what happens when the screen grid voltage of an RF or converter valve is increased or decreased. I have noticed that when I increase the screen voltage of an RF valve it tends to oscillate. Is the sensitivity of the valve directly proportional to the screen grid voltage?

The screen voltage of a pentode valve is important, Tom. The amplification of the valve increases as the screen voltage increases, although not directly so. In a particular case doubling the screen voltage can more than double the amplification and at high screen voltages the amplification goes up at a greater rate than the screen voltage.

The upper limit to the screen voltage is the amount of power that the plate and screen can safely dissipate and as the power dissipation also increases rapidly, with increase in screen voltage, the moral is to keep the screen voltage as high as possible within the limits set by the manufacturer.

Could you tell me why the B battery current is automatically switched off when the A current is switched off?

Yes, Tom, I think we could clear up that point quite easily. The A battery current heats the filaments of the valves causing them to emit electrons. The high positive voltage at the plates, screen, &c., of the valves attracts the electrons toward the plate causing a current to flow in the B battery circuit.

If, however, the A battery circuit is broken the filament will quickly return to normal temperature and cease to emit electrons. This being the case, the current of electrons from filament to plate cannot continue and, therefore, no current flows in the B battery circuit.

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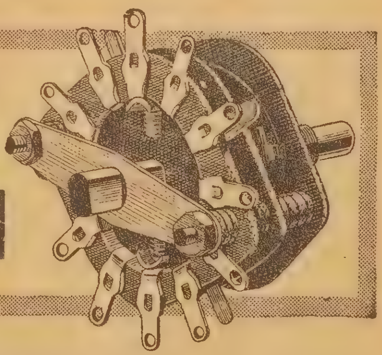

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at 20 " 30° "
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RATING—10 Amp., 250 V.A.C.

CONTACTS—Silver-plated Copper. Non-shorting only.

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1 Pole—max. 12 contacts
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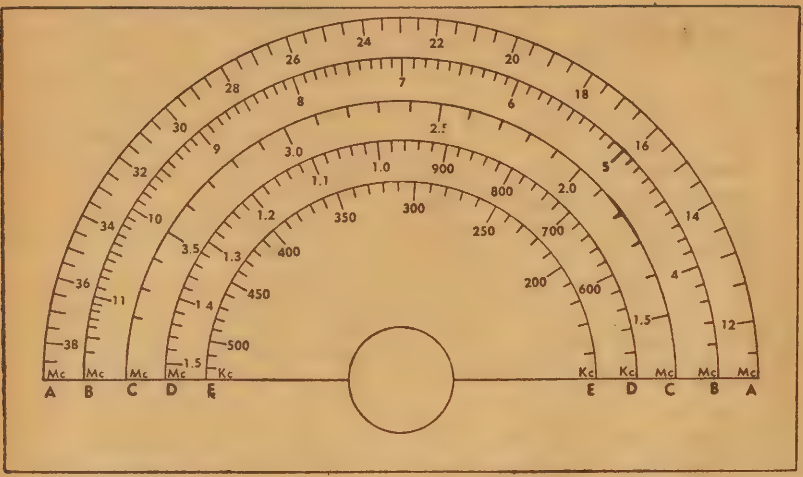


A reproduction of our finished scale. The accuracy and ease of reading of the finished job is well worth the time and effort. The figures can be put on neatly by means of a lettering guide or a good job can be done by hand if care is taken.

CALIBRATING YOUR OSCILLATOR

If your new oscillator is to become a valuable addition to your test facilities it should be calibrated accurately. Believing that expensive laboratory type instruments were necessary in order to do an accurate job, many readers have, in the past, been satisfied with a roughly or incompletely calibrated dial. The purpose of this article is to show how an excellent job can be done with a minimum of equipment.

APART from the oscillator itself, you will need a reasonably sensitive dual-wave receiver. The standard intermediate frequency of 455 Kc is convenient and it should cover the normal broadcast band between about 550 Kc and 1600 Kc. The higher frequency band varies with different receivers, but the top end will be about 20 Mc (15 metres) and the bottom end 6 Mc (50 metres).

The receiver is used merely as an indicator. The accuracy of the calibration of the receiver dial has no bearing on the accuracy of the calibration of the oscillator. It is an advantage if the receiver dial is reasonably well calibrated, but only because it helps to identify the radio stations which are actually used as standards.

HIGHLY ACCURATE

Australian broadcast stations are required by law to maintain their assigned frequency accurate to within a few cycles per second. It would be unusual to find a broadcast station five cycles off frequency. This is very good accuracy indeed, considering that the frequencies are of the order of 1-million cycles per second. You will not be able to calibrate your oscillator to anything like that degree of accuracy, but it is comforting to know that there need not be the slightest doubt about your standards.

The higher frequency ranges are more difficult. At any given time there are likely to be few stations of known frequency which can be positively identified available. However, use can be made of the American frequency standard station WWV, which is almost always audible in this country on either 5 Mc, 10 Mc or 15 Mc.

A simple oscillator is constructed to operate on, say, 500 Kc or 1 Mc and aligned accurately to the required frequency by tuning it until its harmonic is "zero beat" with the frequency standard station.

by Maurice Findlay

Harmonics of this oscillator may then be used for calibration purposes throughout the higher frequency ranges.

A few readily available scrap parts will suffice for the oscillator; the valve can be practically any triode or pentode with a 6.3 volt filament.

Before going into the calibration in further detail, some further discussion of the tuning coils is warranted in the light of extra work we have been able to do since last month.

As mentioned in the previous article, most of the difficulties in the design of the coils are eliminated by the use of the Colpitts arrangement. A single untapped inductor only is required for each range. The capacitive rather than the inductive element of the tuned circuit is divided in order to provide the necessary feedback. Translating the idea into practice with the aid of a standard two-gang capacitor results in a very simple and effective oscillator capable of operating over a wide range of radio frequencies.

There are other arrangements which allow an oscillator to function with a single untapped inductor, but they appear to have disadvantages for our purpose when compared with the simple Colpitts arrangement.

Having simplified the design by the elimination of coil taps and feedback windings, the main difficulty is to provide an inductor to cover the lowest frequency range. For service work there is every argument for going down as far as 175 Kc, with some small overlap, in order to take care of the few remaining receivers using an IF of 175 Kc which come in for service.

The maximum capacity of each section of the tuning gang is 450 pf with the standard unit used in our instrument. However, since the two sections of the capacitor are effectively in series across the tuned circuit, we can only count on 225 pf. A simple calculation from well-known formulae will show that an inductance of 4.5 mH is required with 225 pf in order to tune down to about 160 Kc. The difficulty is to obtain the inductance with a sufficiently low distributed capacitance and efficiency good enough to ensure oscillation.

POSSIBLE ERROR

In this connection, we may have led constructors into possible error by reference to specific RCS chokes. On further checking, it appears that these chokes actually cover between about 300 Kc and 1100 Kc, which can easily be confused with a harmonic of the range between 150 Kc and 550 Kc. Actually, a much larger choke, such as suggested for the Seven Band Oscillator, will be required.

We tried scramble winding a coil by hand, and although it worked, results were not all that could be desired. A large number of turns were required so that the ratio of resistance to reactance was high and the distributed capacity of the coil was excessive.

To ensure reliable oscillation at the high frequency end of the range, it was necessary to instal small capacitors permanently across the coil in order to make an effective division with the disadvantage that the frequency range covered was restricted. If nothing else is available, a hand scramble wound coil will allow you to cover the range, but we recommend that you try for something better.

Accordingly, we looked around to see what could be done with windings which are available in standard components. These windings are made by machine by using a technique which results in good efficiency.

USING OLD IFT's

We tried the various windings of a number of different standard coils. Without going into all the details of our experiments, we found that two windings from 455 Kc IF transformers when placed close together on the same axis and wired so that their self and mutual inductances added gave about the required inductance. (The windings used were taken from IF transformers which were tuned by means of an adjustable slug, with a fixed parallel capacity of 70 pf.)

The cost of a sufficient number of new IF transformers to equip an oscillator with coils in this way would be high. The obvious course would be to try to obtain windings from IF transformers which have been damaged. It usually isn't hard to find some IF transformers with at least one winding intact in a serviceman's collection of scrapped parts.

In our case the first coil, made up of two windings from IF transformers, covered from 165 Kc to 530 Kc.

By removing 125 turns from another such winding, the oscillator was next made to cover between 500 Kc and 1.4 Mc.

If you decide to use this method, take off less than the 125 turns mentioned because it is very likely that you will have a coil of slightly different design. The idea is to make the low frequency end of the band overlap the high frequency end of the next lower band by an amount sufficient to ensure continuous coverage.

HIGHER FREQUENCIES

Following this same procedure we removed a total of 245 turns from a winding to cover the third band between 1.4 Mc and 3.9 Mc.

For frequencies higher than this it is easy to wind the coils with solid enamel wire. We tried 24 B & S on a ½in diam former. To cover a range between 3.7 and 11.8 Mc 34 turns wound close together were required.

Finally, six turns of the 24 B & S wire close wound on a ½in diam former covered the range 10.7 Mc to 36 Mc. If your ranges with the lower frequency coils differ from those mentioned you can odd or subtract turns from the higher frequency coils as required.

At least one manufacturer is making a complete set of coils for the oscillator and they are available at a reasonable cost. This offers a simple solution to readers who are prepared to buy the coils.

All the remarks made about the coils for the oscillator described last month apply equally well to other Colpitts oscillators using a tuning gang of the same maximum capacitance. The use of different valve types or gangs with different capacitance will make little difference since this can be made up by varying the settings of the trimmers.

CALIBRATION POINTS

Frequency	Dial	Frequency	Dial
203	144	340	75
305	92	510	5
290	99	278	105
217	136	167	165
174	162	195	148
158	175	390	54
238	125	423	40
317	86		

For example, with simplicity in mind, some readers may be interested in the mains-operated service oscillator described in the May, 1947, issue. Provided the tuning capacitor is 450 pf per section, the coil data given here may be used. If you do not wish to go down as low as 100 Kc, it would also serve for the oscillator described in the June, 1951, issue.

Before starting on the actual job of calibration, the oscillator should be complete with all parts in their final positions. If there is a shield over the coils as in last month's instrument, it should be bolted firmly in place in such a way that it can be put back in exactly the same position should it ever need to be removed later.

Trimmer capacitors, and slugs if there are any, should be set at the middle of their working range. The idea is that maximum adjustment in either direction is available if it is required.

With a new and untried oscillator, there is a good argument in favor of using it for a time with just the half dozen or so often used frequencies roughly marked on a piece of paper pasted to the front. If some fault which necessitates alteration to the frequency determining circuits makes itself evident, then you will be able to remedy it without fear of the work of calibration going to waste.

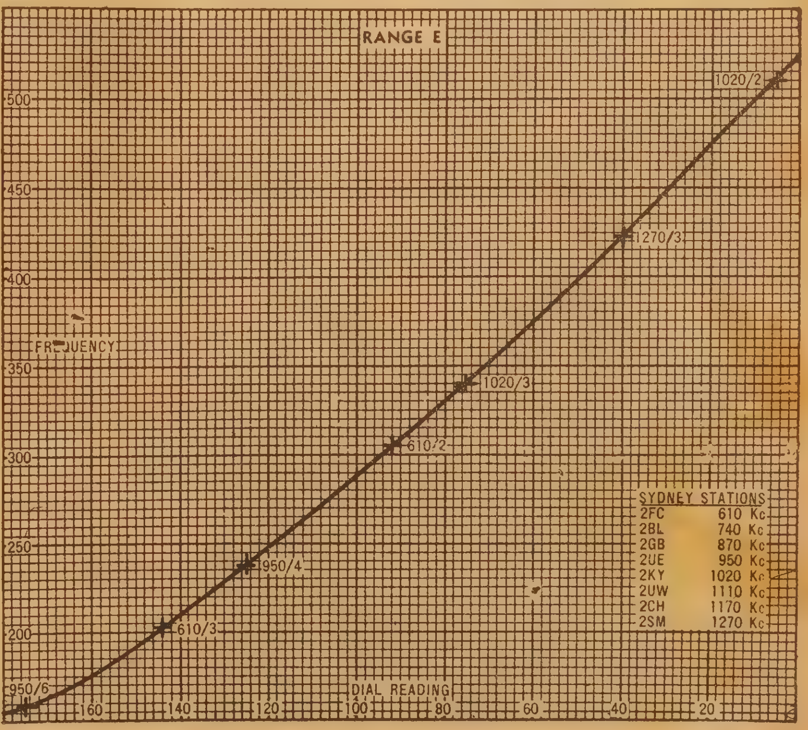
It will also give you an opportunity to check the frequency drift over a period. After a 10-minute warm-up period it should be low enough to be neglected but you may be unfortunate enough to get hold of a fixed capacitor with a high temperature coefficient so that frequency may be be dependant to a noticeable extent on the surrounding temperature or the position in which the oscillator is used.

VERY LITTLE DRIFT

With the oscillator tuned to about 1 Mc, the frequency drift from dead cold to full operating temperature should be less than the width of a calibration mark on the dial. By all means allows the instrument to warm up before beginning the job, but any changes brought about by not doing so would not be too serious.

The first thing is to make up a scale and pointer. The scale is specially for the purposes of calibration and will be thrown away later. Don't buck at this or slum the job because the accuracy of the final scale depends as much on this as on the final marking out.

The scale for the oscillator described last month is 6in by 3½in and



Our graph for the lowest frequency band. It was obtained by heterodyning harmonics of the oscillator with local stations and drawing a smooth curve through calibration points. See table above.

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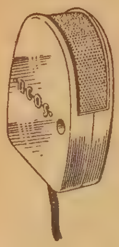

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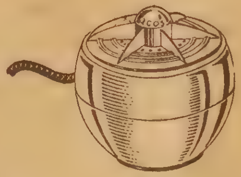

MODEL 33
(DESK)
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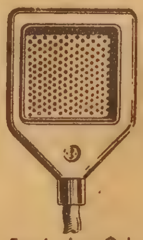

Front view Only

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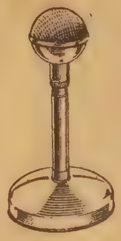

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TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.3-2	General Purpose	1¾in dia. x ⅜in thick	20db Peak at 2500 C.P.S.	Mona	£1 19 3
MIC.3-5	,, ,,	,, ,, ,, ,, ,,	12db ,, ,, ,, ,,	Mervyn	1 19 3
MIC.3-6	,, ,,	,, ,, ,, ,, ,,	5db ,, ,, ,, ,,	Myrtle	1 19 3

MIC. 6 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.6-4	General Purpose	2 1-32in dia. x 19-32 thick	20db Peak at 2250 C.P.S.	Margie	£1 19 3
MIC.6-6	,, ,,	,, ,, ,, ,, ,,	5db ,, ,, ,, ,,	Maudie	1 19 3
MIC.6-11	,, ,,	,, ,, ,, ,, ,,	12db ,, ,, ,, ,,	Mandy	1 19 3

MIC. 14 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.14-5	General Purpose	1 7-16in dia. x 11-32in thick	20db Peak at 3500 C.P.S.	Maxie	£1 19 6
MIC.14-11	,, ,,	,, ,, ,, ,, ,,	12db ,, ,, ,, ,,	Mitchell	1 19 6
MIC.14-12	,, ,,	,, ,, ,, ,, ,,	5db ,, ,, ,, ,,	Malcolm	1 19 6
MIC.15	Hearing Aid	0.9in dia. x 0.155in thick	30db ,, ,, 3000 ,,	Marlene	1 19 6
MIC.17	,, ,,	15-16 in sq. x 7-32in thick	30db ,, ,, 3500 ,,	Maggie	1 19 6
MIC.18	General Purpose	1 7-16 in dia. x 9-32in thick	20db ,, ,, ,, ,,	Maisie	1 19 6

MIC. 23 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.23	General Purpose	1 3-16 sq. x ¼in thick	20db Peak at 3000 C.P.S.	Maureen	£1 19 3
MIC.23-3	,, ,,	,, ,, ,, ,, ,,	5db ,, ,, ,, ,,	Margaret	1 19 3
MIC.23-4	,, ,,	,, ,, ,, ,, ,,	12db ,, ,, ,, ,,	Milton	1 19 3
MIC.32	High Quality	1 13-16 dia. x 9-16in thick		Martin	2 15 6

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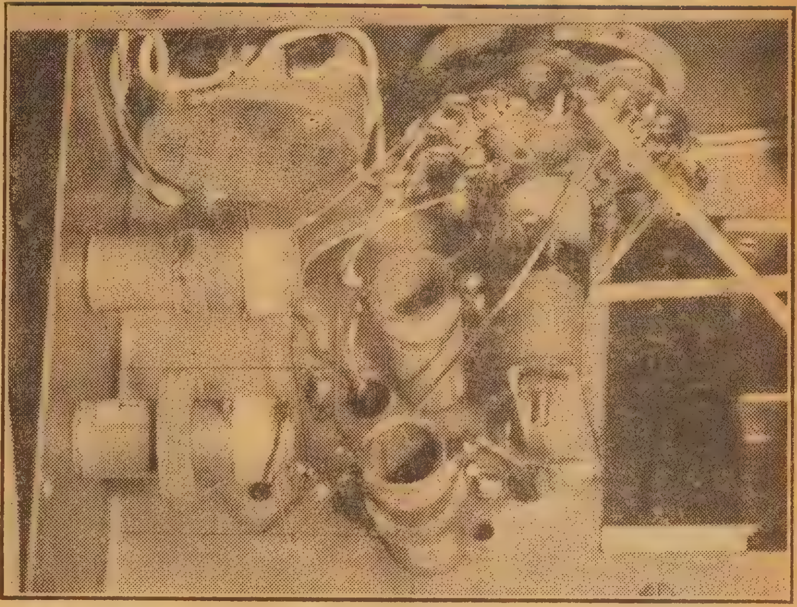
CLOSE-UP VIEW OF THE COILS



A set of commercial coils installed in the oscillator described last month results in a neat layout. Leads connecting the coils with the switch should be firm in the interests of frequency stability.

the actual radius of the outside calibrations 2 5-8in.

If other oscillators allow for a larger scale, all to the good, because the larger the scale the easier it is likely to be to get accuracy.

Some form of reference calibration is required and we suggest you divide the scale into degrees. The full range of the tuning capacitor will then be from 0 degrees to 180 degrees. An ordinary school protractor will serve as a standard.

We obtained one which is a little smaller than the scale and 1 degree points were transferred from the protractor to the scale with the aid of a sharp pencil. It may make things easier if you attach the protractor to the scale with adhesive tape. A rule can be aligned with the centre of the protractor and the particular degree mark and the transfer made by running the pencil against the rule. The only point to watch here is that you make allowance for the thickness of the pencil point.

SCALE OF DEGREES

Make the mark for each 5 degree point a little longer than the others and print the appropriate figure, from 0 to 180 at each 10 degree point. The idea is to make any point on the scale as easy to identify as possible.

The pointer may be made from scrap celluloid. It can be roughly pear-shaped, the large end being the diameter of the knob and the small end roughly ½-inch diameter. Use the sharp point of a scriber to mark a straight line down the centre and fill the indentation with Indian ink to produce a fine, but clearly visible, line.

A couple of bolts about 8BA size can be used to attach the pointer, or if you roughen the back of the knob it can be cemented effectively with ordinary clear nail polish

When you put the knob on the control shaft, make sure that one end of the scale corresponds exactly with the capacitor plates, being fully in mesh, so that you can return to the same setting when the finished scale is placed in position.

Before you go any further you will need to get hold of some writing paper and some graph paper. An old science exercise book of the type you used at school would be just the thing. They have writing pages on one side and ruled graph paper on the other. The graph paper will be 10 inches by 8 inches, with each 1-inch division divided into 10 equal parts.

GRAPH PAPER

If you allow each of the small divisions to equal 2 of the dial divisions, the dial readings can be represented on the longer direction of the graph paper. It will take 9 inches to represent the full 180 degrees. Make a scale along the edge of the graph paper, marking, say, every 20 degrees (every inch).

Knowing approximately the frequency covered by the oscillator on each particular range, you can make a scale for frequency along the other axis. This scale should be over a slightly wider range than you anticipate, so that you will be sure to get the full range on the paper. Take care not to go to the other extreme and try to get too much on the one sheet of paper, because the ability to differentiate between adjacent frequencies will suffer.

In our particular case, with the oscillator switched to the lowest frequency range, it did not go down quite as far as 150 Kc at the low frequency end, or up quite as far as 550 Kc at the high frequency end. By making each of the smallest divisions of the paper equal to 5 Kc the range from 150 Kc to 550 Kc fitted exactly into the 8-inch width of the paper.

SIMPLE DIVISIONS

For the higher ranges try making the dial divisions some even figure. For example, you will find that 20 Kc per division works out fairly well for the next range, and 50 Kc for the following range. If you do not choose some even figure, the job of reading the graph will become too difficult.

Having decided on the scales for your graph, you will be in a position to start the job in earnest.

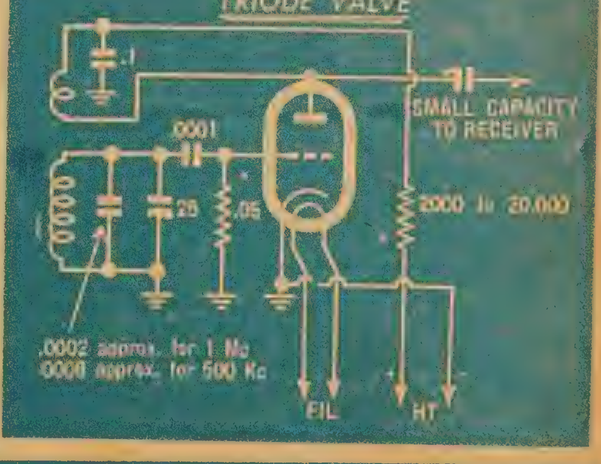
Set up the oscillator and a receiver in a position where all controls can be operated easily. It is specially important that you get a direct view of the oscillator dial to avoid parallax error. If it is on a table of ordinary height, prop up the front with a matchbox

The idea now is to make use of your local stations to establish calibration points on the oscillator dial. At any given location in Australia there should be a range of broadcast stations spread over the entire receiver dial, which can be positively identified. Their exact frequencies are given in the table on page 112. In case you happen to have an older receiver with the dial marked in metres we have given the approximate wavelength in addition

☆

This simple oscillator makes the job of calibrating the high frequency ranges easy. Practically any triode valve may be used and power may be obtained from the oscillator being calibrated if desired. The coil is a standard broadcast oscillator coil. See text.

☆



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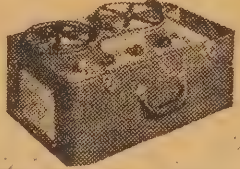

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Tune the receiver to the lowest frequency local station and switch the oscillator to the lowest frequency range with the tuning capacitor fully in mesh. From the coil data you know that the frequency will be somewhere about 150 Kc. Now slowly turn the dial of the oscillator until a beat note is heard and then make a fine adjustment until the signals are zero beat.

If you are using a superhet receiver there is a possibility of confusion with "image" signals. These can be identified by the fact that the beat note changes when the receiver dial is adjusted. If the setting is the one required, the strength only and not the frequency of the beat note will change if the receiver dial is altered.

EXAMPLE OF PROCEDURE

In our case, the receiver was tuned to 2FC, which is on 610 Kc and the first beat was heard about 40 degrees up from the 180 mark. Taking a guess, which subsequently proved to be correct, we said that it was the 3rd harmonic of the oscillator beating with 2FC. By this reasoning the actual frequency of the oscillator was 203.3 Kc.

Moving up the dial further gave us another beat, which could only be 2FC's frequency divided by 2.

We then moved on to 2BL and established several other points on the dial by the same means. Some of the points obtained from several of the Sydney stations are listed in the table. We suggest you adopt a similar procedure.

You are now in a position to mark these points on the graph you have already prepared. For example there is only one point on the graph which corresponds to 203.3 Kc on one scale and 144 degrees on the other scale. Mark in all the points on your list.

SMOOTH CURVE

If everything has been going well you will find that you have a series of points which seem to lie on a smooth curve. Some of them will be bunched close together while others will be far apart. If you are fairly sure of what you are doing, some of the points can be left out. Otherwise put them all in.

If there are a few that do not seem to belong to the curve, you have made a mistake. Where there are plenty of points around that region you can afford to forget the particular point, but it may be that it is a vital point near the end of the band in which case you will need to check again carefully.

You are now in a position to draw a smooth curve through all the points. Quite a good job can be done freehand, but a french curve may make things easier. If some of the points are just a little off the beaten track, it is probable that you have made a small error in reading the dial. You automatically correct for this when drawing the smooth curve. If reasonable care is taken, the final curve should be very accurate indeed.

A similar procedure can be adopted for the next band except that you will be working with the oscillator and the stations on exactly the same frequency over a large portion of the range. For a few points near the low end you may need to make use of the same principle as on the lowest range.

Some difficulty may be encountered with the low frequency end of the middle range. There is a small dodge which may help, however.

First of all, align the intermediate channel of the set accurately to 455 Kc. You can use the previously calibrated low frequency range to do this.

If now you tune the receiver accurately to 2FC on 610 Kc it will also respond to 610 Kc plus twice the intermediate frequency of the receiver—in this case 1520 Kc. The same principle can be used with receivers using other intermediate frequencies.

We are assuming by the way, that the receiver's oscillator is operated on the high frequency side of the signal. The same principle can be applied if your receiver has a non-standard IF.

A beat between an image signal of the receiver and a signal received in the normal way can always be identified by the fact that the beat note alters when the receiver dial is moved. For this reason it is essential that you tune as accurately as possible to the station being used as a standard.

It will probably not be possible to get as many calibration points on the second and third ranges as on the low frequency range, but here you will be aided to some extent by the general shape of the curves, which are similar for all ranges.

An entirely different approach is required to obtain the calibration points on the higher frequency ranges. You will need a receiver with shortwave bands. It need not be calibrated accurately, although it does save time if the various frequencies can be identified easily.

Playmaster correction

THE value of the bias resistor for the EF86 in the Playmaster No. 6 described last month was incorrectly given in the circuit and parts list. It was shown as 680 ohms, but it should be 2000 ohms. The correct value was used in the original equipment but a mistake crept in during the circuit preparation.

The idea is to make use of the accurate frequency transmissions of the American organisation, the National Bureau of Standards, through their station WWV. This station maintains powerful transmitters on a number of frequencies. The order of accuracy of the frequency of the transmissions is extremely good.

In this country you are most likely to hear the transmitters operating on 10 Mc, 15 Mc and 20 Mc. Considering the ranges covered by most receivers and propagation conditions, the 15 Mc standard is often the most useful. The carriers are modulated by audio tones, but the most characteristic thing about the signals is that there is a tick every second. The audio is switched off every so often and the entire operation is very precisely controlled. However, the main thing that we are interested in is the carrier frequency.

Having identified the station, the next job is to make up a temporary oscillator to operate on a low frequency and beat the harmonics of this oscillator with WWV. For the lower ranges, 500 Kc is convenient, and 1 Mc for the higher ranges.

An oscillator built to the simple circuit published can be operated from any power supply or even from the power supply of the oscillator being calibrated, provided the regulation is sufficiently good not to cause a significant change in frequency. The values we have given for the tuning capacitors are approximate only and should be checked by experiment.

It should be reasonably easy to get a beat between the harmonic of the temporary oscillator and the fundamental of WWV. However, make sure that it is the 15th harmonic of the oscillator when you are aiming for the 1 Mc setting. The 14th harmonic would also give a beat but the oscillator would actually be on 1.07 Mc. The difference between the two can be positively determined by switching the receiver back to the broadcast band.

You are now in a position to establish a whole series of points on the short-wave ranges. For much of the time you will be able to work with the receiver tuned to the fundamental of the oscillator output, beating it with the harmonic of the calibrating oscillator.

It is a good idea to tune back to the 15 Mc occasionally to make sure that the harmonic of the oscillator is still beating with WWV. It may not be possible to hold an accurate beat note with such a simple arrangement but it should remain within the audible range.

Over certain parts of the middle range, it will probably not be possible to tune the receiver to the fundamental of the oscillator output. In this case it is quite in order to tune the receiver to a harmonic. For example, in finding the 2 Mc setting you could tune the receiver to 8 Mc and the 8th harmonic of the calibrating oscillator would beat with the 4th harmonic of the instrument.

HIGHER FREQUENCIES

A greater number of calibration points will be obtained if the 500 Kc setting of the calibrating oscillator is used for the middle range. However, when working with the higher ranges the large number of points becomes rather confusing and it is better to stick to the 1 Mc.

Throughout the entire operation, bear in mind that the strength of the two signals should bear some relation in order to get a good beat. The attenuator of the oscillator provides a ready means of controlling its output.

With the usual run of receivers the foregoing procedure will serve for frequencies up to 20 Mc or so. However, it is necessary to develop yet another procedure in order to hear the beats at frequencies higher than covered by the receiver.

We overcame the difficulty by connecting a germanium diode in parallel with the input of a high gain amplifier thus turning it into a simple signal tracer. The outposts of the two oscillators were simply connected in parallel across the diode. The beats were fairly weak at the extreme high frequency end but there was no difficulty in identifying them.

Having drawn the graphs for the complete range of the oscillator it is a simple matter to determine the exact dial settings for even frequencies and transfer them back to a permanent dial scale.

The entire job may occupy a few evenings. Actually, it isn't as complicated as a first reading of this article may suggest. The method is capable of yielding a very high order of accuracy and the finished job is well worth while.

FROM THE SERVICEMAN WHO TELLS

Every so often a serviceman is faced with the question of whether to repair a component or replace it. While it is generally most satisfactory to replace it there are occasions when a repair is perfectly legitimate. The two cases I am about to describe are typical.

CASE number one was a mantel set of the larger variety, and which was old enough to employ one of the once standard electromagnetic speakers. Apparently it had been out of commission for a lengthy period and had been stored in some out-of-the-way corner of the owner's garage.

Thus, it was that as I received the set it was covered in a thick layer of dust and cobwebs and had a faint, though quite unmistakable, odor about it.

"SMELLS A BIT"

"Smells a bit musty, doesn't it?" remarked the owner, then added, "Still I suppose a bit of a clean-up will fix that."

I agreed that it did smell a bit, though I would have liked to qualify that word "musty". Many years of experience told me that that particular smell could mean only one thing—mice.

On removing the chassis from the cabinet my suspicions were confirmed for out fell a mass of torn paper, food scraps such as flakes of breakfast cereal, breadcrumbs, &c., small bundles of fluff and fur, plus a considerable amount of organic matter in a form not usually mentioned in polite society.

As I say this was not an unusual experience, particularly in country districts. Nor is it confined to sets which have been stored. On the contrary, those in regular use are just as likely to be affected. It seems that the rodents are attracted by the warmth, and they can usually find an opening of some kind to the underside of the chassis. Once there, the prospects appear so good that Mr. and Mrs. Mouse decide to move in right away, build a nest, and raise a family.

Even if this is all that happens it can be bad enough, since they leave behind them the unmistakable "atmosphere" which I mentioned earlier. It frequently happens, however, that fate takes a hand. The mouse, being woefully ignorant in matters electronic, cannot appreciate that the wires and terminals so close at hand are dangerous and, as often as not, electrocutes himself. In a few days the body, aided by the heat of the valves . . . . Well, you know what I mean.

LIVED IN COMFORT

In this case it was somewhat different. For one thing there had been no danger to the occupants while the set was stored, and they had simply raised their family and moved out, leaving behind them the nest—and the smell. However, the really important point was the place they had chosen to make their nest, for it had been neatly constructed in the framework of the speaker, against the base of the cone and around the suspension system.

Having cleaned away the mess, I examined the speaker. At first glance it seemed that very little damage had been done. At least the particular type of glue used had apparently not appealed to the palate of the mouse family and the cone and suspension spider were intact.

But here the luck seemed to run out. Pressing the cone inward indicated that it was well out of alignment, the voice coil rubbing badly against one of the pole pieces.

In the meantime I decided that it should at least work sufficiently to get the set working in a general way, after which I could consider the best method of repairing it. Remembering that the owner had stored it because it had failed, I assumed that there was a definite fault of some kind, apart from the damage it had suffered while stored. This was confirmed when I switched it on, for it was completely dead. No signals, no static, no audio from the grid cap.

CATHODE VOLTAGE

I measured the HT, which appeared normal, and then the other voltages on the power valve. All appeared normal until I reached the cathode, where I found a voltage almost equal to the HT. The cause of this did not take much finding, the ohmmeter confirming that the cathode bias resistor was open circuit.

Usually when this happens the bypass condenser breaks down, due to the high voltage across it. In some cases the set continues to work, after a fashion, the condenser providing sufficient resistance to partially bias the output valve and keep the distortion within reasonable limits. Strangely enough, this condenser did not appear to have suffered any damage and as far as I could see it functioned normally when I replaced the cathode resistor. However, I replaced it to be on the safe side.

The set now showed signs of life but with some hum and the distortion from the speaker. The HT had dropped by nearly 100 volts and this fact, coupled with the hum, suggested that the first electrolytic in the filter network had failed. Sure enough, this proved to be so and a new condenser cured the hum and restored the HT.

With the hum eliminated, the reproduction sounded a little better, though it was still far from perfect. Before I had a chance to really check the speaker properly, the signals suddenly ceased for no apparent reason. A clue to the fault was given by the fact that the set still sounded lively and seemed normal in every way except that it wouldn't receive any signals. (Maybe that sounds a bit cock-eyed, but you know what I mean.)

Behavior of this kind always suggests a failure of the local oscillator circuit, this having the effect of restricting the signals received to any that happen to occur on the intermediate frequency.

About the only other possibility of receiving any signals under these conditions occurs when there is another receiver operating in the vicinity, particularly if it is working from the same aerial or the two aerials are very close together. Under these conditions it is possible for the faulty set to pick up IF signals from the good set and it will play whatever program the good set happens to be playing. At this point I will digress for a few paragraphs to retail a rather humorous aspect of this technical peculiarity.

BOYS WILL BE BOYS!

In the days when I was a factory worker it was not unusual to see a new chum "caught" by this phenomena, much to the amusement of the old hands. It would sometimes happen that a set from the assembly line would reach the test bench functioning correctly in every respect except for an inoperative local oscillator and one of the old hands would be quick to seize the opportunity for some fun.

Since there were usually several sets in the immediate vicinity it was easy to get one of these into operation and on to a station just about the time the new chum had decided that there was something wrong with his set and that it was not going to play. Just as he would be on the point of turning the set over to probe its innards, it would suddenly commence to play. (The other set would have its audio section turned well down.)

Then, equally as suddenly and mysteriously, it would change to another program, then stick doggedly to it, no matter how the puzzled operator tried to tune it out. I am quite sure that some of the more superstitious types were convinced that the set was haunted, while in all cases the look of bewilderment had to be seen to be appreciated. Thus they learned, very effectively, the lesson of the faulty oscillator circuit.

DRY JOINT

In this case the fault was not hard to find for it was easy to see that the filament of the converter was quite cold. Further examination showed that the filament was open. I adopted what I now regard as a standard procedure, that of resoldering the base pins. Every so often this pays off and, since it takes only a few seconds, it is well worth while. This happened to be one such case and I was able to restore the set to operation without a new valve.

Now came the problem of the speaker. The ideal arrangement was simply to return it to the makers and have them fit a new cone. Unfortunately I encountered a problem which occurs quite frequently at the present time, namely, that no new cone was available for this type of speaker. The makers advised that they considered the speaker too old for economical repair and that the most satisfactory arrangement would be to fit a new speaker.

EXPENSE PROBLEM

Knowing that the owner did not consider a large outlay justified, I felt that this solution to the problem might not be a very satisfactory one. This was the more so because of the additional expense which would be incurred in modifying the layout to take a modern permag speaker and the necessary choke and dropping resistor. All things considered I felt that it might be worth while attempting to repair the speaker. In any case there was little to lose because the speaker in its present condition was virtually useless.

On the other hand, it was not a type which readily lent itself to adjustment. The spider was supported by a metal ring, fastened to the main frame at two points.

It was these two mounting points which were of vital interest because, as far as I could see, they completely controlled the voice coil alignment. If they could be slackened slightly, the metal ring moved in the right direction by the right amount, and the screws tightened again, it should be possible to correcty align the voice coil.

At least it was a very nice theory, but putting it into practice was not so easy. The two screw heads which had to be loosened were close up behind the cone and hardly accessible with a screwdriver in the ordinary way. Then there was the question of how to actually centre the voice coil. The old trick of inserting spacers between the inside of the voice coil and the centre pole piece was not very suitable, mainly because the front of the voice coil was closed with a disc of dustproofing material.

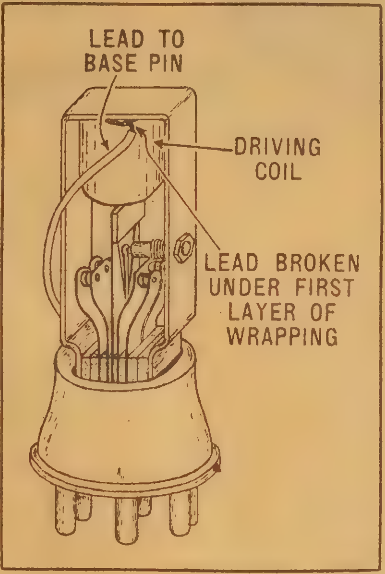
TOO FLIMSY

It might have been possible to un-stick this and replace it later, but, considering the abuse to which the cone had already been subjected, I deemed it wiser not to tempt fate. Instead, I had another look at the all important screws. This time I decided that I might just get a spanner over each head with enough room to give each a slight turn. If so, this would be sufficient, because I merely required to ease the tension slightly.

First, however, I determined as accurately as I could the direction in which the assembly needed to be moved in order to centre it. This was done by pressing lightly on the cone in various directions while it was handling signal and noting the one which seemed to clear the movement best.

That done I tackled the screws and managed to ease each one a fraction of a turn. Then, with signal fed to the speaker, I applied gentle pressure to the metal ring by holding a blade of a screwdriver against it and tapping the handle lightly with a hammer. I'll admit it sounds a bit "butchery" but it wasn't quite as bad as it may appear.

The important point was that the idea seemed to be working. By judicious tapping on various parts of the ring, as indicated by the performance, I was able to coax the voice coil into a position which, if not central, at least allowed it free movement. Having satisfied myself that it would handle a reasonable volume without distortion I tightened the screws and checked it again. When it appeared to survive this last stage I considered it as good as it was ever likely to be and returned it to the owner.



By coincidence the same fault occurred in two auto sets; a broken lead to the driving coil prevented the vibrator from starting reliably.

CAR RADIOS

My second case concerns two faults—or rather the same fault twice—in a couple of car radios. These sets normally represent only a small proportion of those handled, so it was something of a coincidence when I had to repair two within a day of each other, both with the same fault.

The first one was completely dead and my first test was simply to put my hand on the case to see if the vibrator was working. As far as I could tell it wasn't, and I remarked to the owner that the trouble appeared to be a faulty vibrator. He immediately replied that he hoped it wasn't, because he had only recently had a new one fitted and that it had not had a great deal of use.

I pointed out that the fault might not necessarily call for a new cartridge, and that it could be due to a number of defects in the complete power supply. The most obvious possibility, that of a blown fuse, was immediately discarded because the dial light was functioning normally.

This being an installation where the power supply was a separate unit and mounted on the bulk head, it was reasonably easy to get at. (Yes, there really are such installations!) I slipped the cover off and touched the can of the vibrator. It was completely dead. I tapped it several times to see if it would start, but there was no response.

The next step was obviously to replace it with a known good one, which I did, and this started immediately. As far as the owner was concerned, this was convincing proof that a new vibrator was needed, but I pointed out that we might yet be able to salvage the old one.

Whether a faulty cartridge is worth salvaging is a debatable point, and the general opinion is that there is not much future in trying to restore one which has run its normal span. This is generally sound advice, because there are many factors involved in the correct adjustment of a vibrator.

ANGLE OF CONTACT

Even assuming that one succeeds in dressing down the pitted contacts to something like their new surface, there is the all-important factor of the angle of the surface, relative to that of its opposite number. What generally happens is that the two contacts meet on one edge or at a high spot on one or both of them. In either case the area is too small to carry the current and overheating results.

The gap between the contacts is also critical and, assuming that some of the surface has been filed away, this will need to be restored. This is not an easy task without a lot of experience, though it is possible to make a reasonable job if one is able to observe the waveform on a CRO and to spend plenty of time on the job.

But now comes the biggest snag of the lot. The original pitting of the contacts will almost certainly have caused them to overheat badly. This, in turn, will heat the supporting springs sufficiently to draw their temper, making it virtually impossible to retain the critical adjustment of the springs for any length of time.

NOT WORTHWHILE

On odd occasions in the past, generally where there was no replacement available and it was important that the set be made to work, if only for a few days, I have attempted to restore a cartridge which would otherwise have been discarded. In all cases I have encountered the above problems either singly or collectively (usually the latter) and have always come to the same conclusion, namely, that the repaired cartridge is not likely to last long enough to justify time spent in repairing it.

However, a cartridge which simply refuses to start, and a comparatively new one at that, is quite a different matter and usually warrants some investigation. The first thing is to measure the resistance across the driving coil (pins 3 and 6 in the usual style cartridge) and in this case it indicated a complete open circuit.

Next I slipped the works out of the can and measured across the driving contacts. These appeared to be intact, though it is not unusual for them to be the cause of starting failures. In some cases the frame contact has not been locked properly with the lock nut and has worked loose, thus opening the gap with the reed at rest.

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Another one I have encountered n a few occasions is a dry joint the base pin connecting to the riving coil. Alternatively the lead ometimes breaks off inside the pin

ESS CRITICAL

The actual contacts also give rouble at times. These are not uite so critical as the current carrying ones and it is usually possible o clean them with a "points" file nd, if necessary, adjust the gap y means of the screw provided.

But in this case it was none of hese. I was on the point of deiding that the driving coil itself vas open and that it would have o be discarded, when the fault evealed itself. The driving coil ead was apparently broken at a oint just after it turned under the op layer of wrapping around the oil. Until I handled the wire a ew times there had been sufficient nechanical grip to hold it in place.

To effect a repair it was only ecessary to strip back a small piece f covering, recover the broken end f wire, and solder it to the lead rom the base pin. However, I adnit that I am at a complete loss o explain just why the lead broke n the first place. There was no ign of green spots which might uggest corrosion and I am more nclined to the theory that the nechanical vibration is to blame.

DENTICAL FAULT

Weight was added to this theory when I encountered an almost identical fault the next day. Once again it was a car radio and once again it was completely dead. The main difference, as far as symptoms were concerned, was that the owner claimed that the trouble seemed to be intermittent, it usually being possible to coax the set into operation when the car was moving but it flatly refused to work when it was stationary.

As before, I felt the side of the set for signs of vibration and, finding none, gave the case a hearty slap with the palm of my hand. The set immediately roared into life and appeared to function quite normally. The vibration could now be felt quite strongly, so there didn't seem to be any doubt that the vibrator was at fault.

I switched the set off and then on again, but the vibrator refused to start without help. I repeated this several times just to be quite sure. At this stage it was fairly obvious the vibrator was a poor starter and that this was the cause of the intermittent effect, the vibration of the car being sufficient in most cases to set the thing going.

This was a single unit installation and I had to take the whole set out to get to the vibrator. Set up on the bench it behaved much as before and I was quite convinced that the reed contacts were at fault. The most usual cause of this effect is a very small gap between these contacts when the reed is at rest. This means that no current can flow through the driving coil until something happens to temporarily close the contacts. Once this happens and the reed commences to move the spacing of the contacts becomes less critical and the vibrator will usually function normally.

I slipped the "works" out of the can and plugged them back into the receiver socket. Then I tried to start the reed by twanging it, but without success. Somewhat puzzled by this sudden stubbornness I moved the works around on their base, whereupon the vibrator started, then just as suddenly stopped again. The whole thing was far more erratic now than it had been previously and was behaving more like a broken lead than faulty contacts.

Hardly had I commenced to examine the driving coil lead when it broke exactly as it had on the previous occasion, just under the outside layer of the coil wrapping. As before it was a simple matter to fix.

HIGH RESISTANCE

As far as I can see the effect was simply that of a high resistance connection. Presumably the break in the wire was of such a nature that it did not completely open the circuit but merely added several ohms of resistance. This was of such a value that the driving coil was unable to draw sufficient current to start the reed vibrating.

However, the current required to start the reed is very much more than that needed to keep it vibrating so that, once started, it was possible for enough current to flow through the driving coil to keep things moving, in spite of the added resistance.

To substantiate this theory I made a few measurements on a similar cartridge and the results may prove interesting. The resistance of the driving coil is approximately 10 ohms, which means that a six volt battery would force 600mA through it. (I hope my Ohm's Law and maths don't let me down.) This, then, would be the starting current but you won't be able to measure anything like this value when the reed is vibrating, the same cartridge drawing only 175 mA.

The explanation is, of course, that current only flows during a small part of the reed cycle and the value shown on the meter would be an approximate average. Thus the reed was able to keep vibrating once started.

EFFECT ON STARTING

Another way of looking at it is to consider the voltage distribution in the various parts of the circuit. With the reed at rest it is likely that most of the 6 volts was applied to the high resistance joint, leaving only a very small voltage to be applied to the coil. Under these conditions the joint resistance would be much higher than the coil resistance.

Once the reed commenced vibrating the coil's apparent resistance would rise, probably making it as high as, or higher than, the joint resistance. The voltage applied to each would now be more nearly equal or probably in favor of the coil. Allowing that these devices are made to work over fair voltage range (some will operate on 2 volts it is not surprising that it managed to keep going.

In assessing the above operating conditions it is important to realise that the inductance of the coil would also have some effect, presenting additional impedance when it was being fed with pulsating DC. However, to delve too deeply into the relative proportion of each effect would only cloud the issue, the important point being the reason why the vibrator would not start but operated once set in motion.

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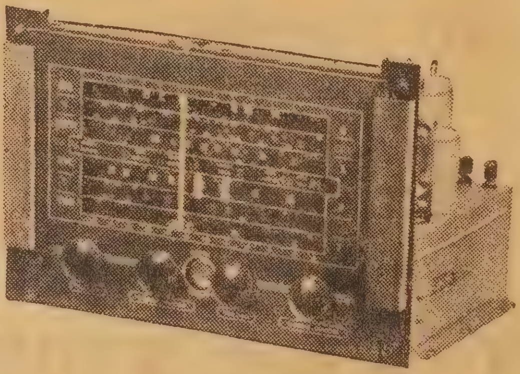

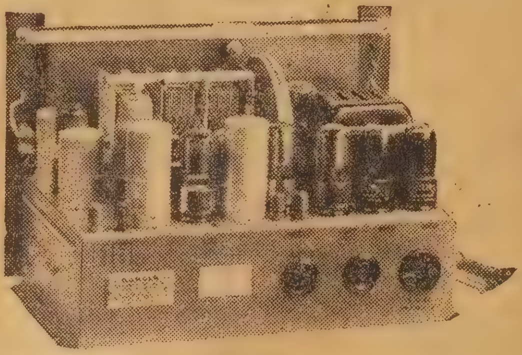

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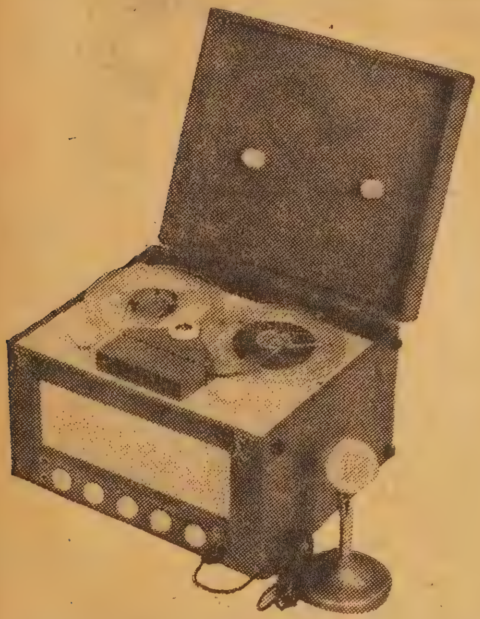

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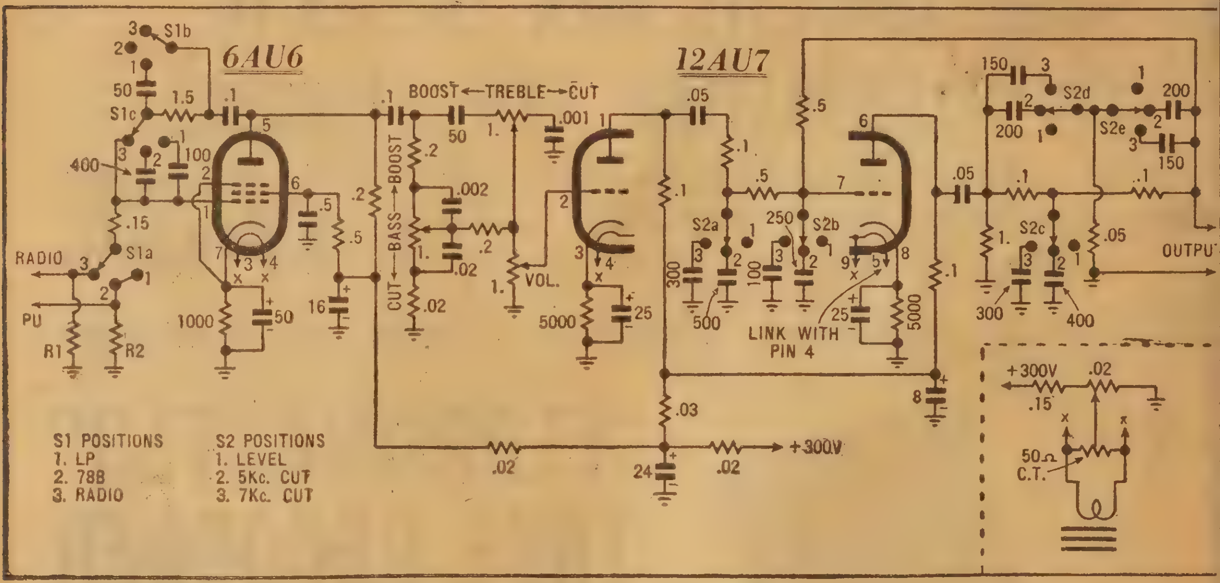

Here is a unit which should prove of interest to many of our audio-minded readers. It consists of a single stage of fixed record compensation and variable tone control followed by a stage having a sharp cut-off characteristic at 5 Kc and 7 Kc.

THE circuit diagram was submitted by Mr. C. Hart, of 12 Waverley St., South Perth, Western Australia. Although sections of the circuitry have been published previously both in this magazine and others, the combination is rather versatile.

The first stage employs a 6AU6 with the gain modified by a negative feedback loop between anode and grid. The feedback loop is made frequency - conscious for positions 1 and 2 of switch S1 to give fixed bass boost and treble cut for LP discs and bass boost for 78 British discs.

EFFECT ON GAIN

The action of the capacitive-reactive elements in the feedback loop is to increase or decrease the amount of feedback, and, inversely, the gain, in the upper and lower register.

The value of the resistors from the switch section S1a to the chassis will be dictated by the requirements of the radio tuner and the pick-up. For a magnetic type, the load resistor would probably be of the order of .03 megohm.

The value for a crystal pick-up may need to be obtained by experiment, bearing in mind the inherent bass boosting when used with large values of load resistance and the bass boosting already provided in the unit. Too high a value will alter the feedback somewhat.

You may need to deliberately reduce the output from the radio tuner with a suitable divider to avoid overloading the 6AU6 grid. The input resistor could be one of the two resistors in such a divider.

The output from this stage is taken to a split load with one section handling the bass control and the other the treble.

The bass control load acts as a frequency-conscious divider across the output of the stage. With the bass control turned to one extreme where it shorts out the .002 mfd, the value of the portion of the load between the moving arm and chassis rises as the frequency falls from around, say, 1000 cycles. In so doing it effectively increases the drive to the next stage at low frequencies.

When the bass control is at the other extreme, it shorts out the .02 mfd capacitor and the lower portion of the divider remains fixed for any frequency. However, the .002 mfd capacitor raises the gain substantially to the reference level at and beyond about 1000 cycles. The overall effect is to attenua the bass frequencies.

When the treble control in th other load is toward the 50 pf capa citor, the frequencies beyond abo 1000 cycles are fed to the volun control in a manner which gives in creasing gain with rising frequenc This gives treble boost.

At the other extreme of the con trol, the .001 mfd capacitor is plac across the volume control to effe tively bypass the treble with ri ing frequency. This gives treb cutting.

Decreasing the value of the treb control capacitors will shift the c and boost curves along the refe ence level line toward the high fr quency end. Increasing the valu will shift the curves in the opp site direction. Increasing the valu of the bass control capacitors w move its cut and boost curves t ward the low frequency end an vice versa.

SHARP CUT-OFF

The bass and treble controls ca be used to compensate for vari tion in recording characteristic or suit individual taste in reproductio

The function of the 12AU7 sta is to provide some gain and to i troduce a sharp cut-off characteri tic in the response at selected fr quencies.

The roll-off in response throu the low-pass filter between the tw

:ctions of the valve is not suffi-
ently steep for satisfactory top-cut
.tering, and to obtain a sharp knee
the curve, the output is taken
ırough the second half of the 12AU7
hich has a feedback loop controlled
a parallel-T network.

In addition to this sharp knee, it
necessary to have a fairly high
ıte of attenuation above the reso-
ant frequency of the parallel-T net-
ork. Introducing a lagging phase
ıift with a shunt capacitor, from
ıe second grid to chassis unbal-
nces the characteristic of this net-
ork.

The overall effect is that the re-
ponse of the 12AU7 stage falls
harply beyond the selected cut-off
requency, rises by a small amount
nly immediately following the reso-
ant point of the parallel-T network
nd falls again due to the shunt-
ng of the phase-shift capacitor at
he grid.

EVEL RESPONSE

Component values in the paral-
el-T network and the low-pass fil-
er are switched to give cut-off fre-
uencies of 5 Kc and 7 Kc. Position
of this switch leaves both net-
orks out of circuit to give a level
esponse.

The sharpness of the cut-off is
ependent upon close tolerance in
he values concerned. Ideally, the
esistors and capacitors associated
vith switch sections S2c and S2d
hould be of 1 pc tolerance and
hose of switch sections S2a and S2b
f 5 pc tolerance.

In view of the total amount of
ass boost available, our contributor
ound it necessary to use all of the
igh tension line decoupling shown
n the circuit. The main amplifier
ısed was the Playmaster No. 2 of
he November, 1951, issue of Radio
nd Hobbies.

Further, he found it best to raise
he valve heaters above chassis po-
ential by a high value divider across
he HT. This could be achieved
lso by connecting the 6.3 volt wind-
ng centre-tap, or an artificial cen-
re-tap to the cathodes of the out-
ut valves in the main amplifier.

TELEPHONE TRAFFIC

(Continued from Page 7)

inually working on it to effect im-
rovements, the need for which can
nly be shown by actual use. When
he time comes to purchase new
quipment it will incorporate these
mprovements.

Of long range interest is the possi-
ility of using microwave links for
elaying television programs be-
ween cities. The production costs
f television programs are so tre-
ıendous that it is well worthwhile
o relay them to centres other than
hose at which the programs origin-
te. It is possible that in the future
ydney will be linked with New-
astle, South Coast towns and towns
o the west of the Blue Mountains
y SHF radio systems. In the mean-
ime, local engineers are gaining
aluable experience in the operation
f this type of equipment.

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7 x 7,	3/3	20 x 9,	12/3
9 x 8,	4/10	24 x 12,	19/6
12 x 8	6/6		

18 Gauge .040 thick.

7 x 7,	2/6	18 x 9,	8/6
9 x 8,	3/8	16 x 12,	9/9
12 x 8,	4/9	20 x 9,	9/3
14 x 8,	5/9	24 x 12,	14/6

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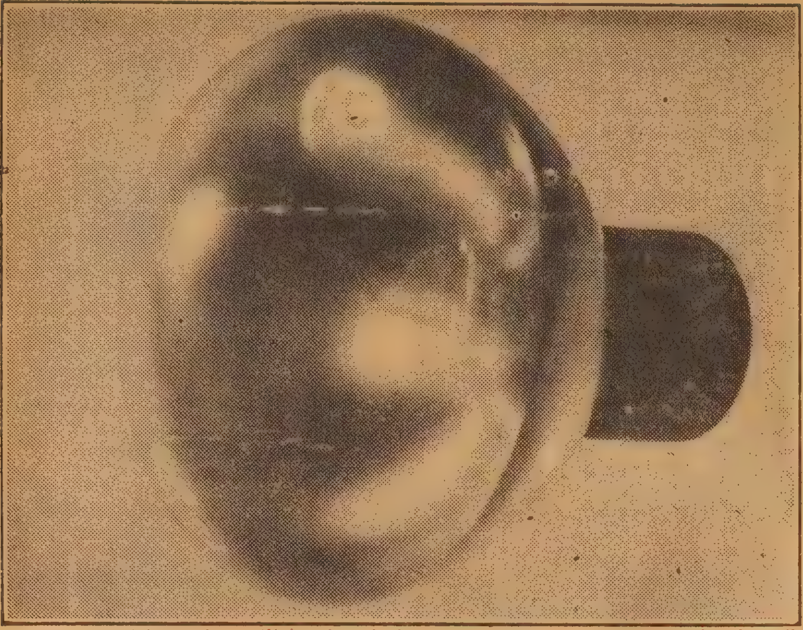


One type of low voltage flash tube which is popular overseas is the "sealed beam" design. Although dearer than the standard type it has the advantage of a high quality reflector which is protected from tarnish and damage. This type is likely to be available in Australia shortly.

ELECTRO-FLASH DESIGN TRENDS

A little over twelve months ago we described the Radio and Hobbies Electro-Flash, an electronic flash unit for photographic lighting. The recent arrival of new type, low voltage, flash tubes from overseas gives promise of many improvements in design, some of which we discuss

AT the time we described the original electro-flash it was just about as good a design as was possible with the then available equipment. In addition it offered the home constructor a unit at about half the cost, or less, of the commercial units; and, in most cases, had a much higher output.

WEIGHT PROBLEM

But, looking at the matter objectively, it must be admitted that all flash units of this era suffered from one serious disadvantage, namely, weight. By the very nature of the components used it was virtually impossible to reduce the weight below about 14lb, assuming a light output which was reasonably close to the maximum rating of the tube (100 joules).

It is true that some so-called light weight units were avialable, but but these only achieved a reduction in weight at the expense of light output so that in many cases, particularly where grain was a problem, the light was not useful at distances of more than a few feet.

One of the heaviest single components was the capacitor, this being a specially-designed, oil-filled type, and which was rated at 2500 volts only on the assumption of intermittent use. Even so a unit to store 100 joules weighed 6½lb, and to this had to be added the battery, vibrator transformer, vibrator, and sundry minor components. The result could hardly be less than the figure quoted.

A better compromise between light and weight was provided by using a capacitor which reduced the light by only 13 pc, but saved nearly 2lb in weight, and this was a very popular arrangement. Nevertheless, the equipment was still rather bulky for some applications, and there has always been a desire to make a really worthwhile saving in weight without sacrificing performance.

At one time this appeared to be an almost impossible task, and, in fact, one writer a few years back went so far as to say that a satisfactory unit weighing less than 10lb would never be made. Doubtless, h is now quite happy to eat his words because the 10lb limit appears t have been well and truly beaten.

All this has been brought about by the low voltage flash tube. Thes have been popular overseas for som time and their progress, and tha of the circuits developed to go wit them, has been followed with considerable interest. However, ther was little point in describing suc equipment until ample supplies o the tubes and associated gear wer readily available.

SUPPLIES SOON

It now appears that the suppl position will be good in a few week time, and we already have sample on hand for experimenting. B the time we describe a suitable uni there should be ample stocks available.

In the meantime, a general discussion of the low voltage tubes an the circuits they make possible wil help to introduce the new technique in anticipation of the practical description.

By low voltage tubes we mea tubes operating at voltages of 50 or less, and there is a very goo reason for selecting this figure a the line of demarkation. This i because 500 volts is about the to practical operating voltage for electrolytic capacitors, and it is the us of electrolytics which provides on of the biggest savings in weight.

At the present time there appea to be three popular voltages; 50 250, and 180, and of these the 50 and 250-volt types are most likel to be available to the amateur. Th supply position for the 180-vol types is somewhat obscure at th moment.

To meet the particular requirements of photoflash equipment th capacitor manufacturers have developed special electrolytics, whic are extremely efficient. Typica values available are: 120 mfd an 200 mfd, both at 500 volts, 650 mf at 250 volts, and 900 mfd at 18 volts.

SUITABLE TYPE

The unit most likely to interes our readers is the 650 mfd typ and some figures about it may be c interest. It is 4 3-8in. high, excluding terminals, 1¾in in diamete and weighs a fraction over 8 ounce It will store 20 joules of energ which means that a combination c five units would weigh only 2½lb— a clear saving of 4lb.

When functioning correctly the should have a leakage of less tha 1mA per unit, which is extremel

AT the time of going to press we are experimenting with some samples of the new tubes and preparing a constructional article to be published as soon as possible. Since we wish to be sure that these and other components will be available in quantity when the article appears it may be delayed for a month or so, but readers may rest assured that such an article is on the way. We are also preparing some additional data on the expendable type flash bulb to supplement that published in the January issue.

mportant if good operating economy is to be obtained.

In addition to making possible the electrolytic capacitor the low voltage flash tube has several other advantages. One is that the flash is of longer duration, varying from 1/750 second to 1/1000 second. The high voltage units varied from 1/3000 to 1/5000 second. To those who were intrigued by the ability to freeze very fast action this may appear as something of a disadvantage, but the advantages far outweigh it.

One of the big disadvantages of the very high speed flash was its adverse effect on film speed. This is known as the failure of the reciprocity law or, more usually, reciprocity failure. The exact reason for the failure is not quite clear, but it is a fact that above about 1/1000 second most emulsions show a marked falling off in sensitivity. This means that a decrease in exposure time can no longer be compensated for by an equivalent increase in light. In other words, the simple reciprocal law which holds at all normal shutter speeds, breaks down; hence the expression, reciprocity failure.

GREATER EFFICIENCY

Thus, all else being equal, a given amount of energy will be more effective in terms of exposure, if it is spread over a period of 1/1000 second than if it is discharged in 1/5000 second. On the other hand, 1/1000 second is still extremely fast in terms of most moving objects and certainly fast enough to "stop" any action which the average amateur is likely to encounter. The only exceptions would be bullets in flight, light globes in the process of shattering, &c.; but work of this kind must be regarded as either highly specialised or as having a novelty value only.

It is also interesting to note that the physical size of the latest tubes is much smaller than previous types, and this is important when considering the type of reflector required. Normally the smaller the light, or the nearer it approaches the theoretical ideal of a "point source", the easier it is to make an efficient reflector of a reasonable size. Conversely, a reflector of given size will normally be more efficient when used with a small light source than a larger one.

These factors should result in a worthwhile increase in light efficiency so that energy values may be decreased while still preserving adequate exposure figures. This results in a further saving in weight.

Another advantage is that the lower voltage is less exacting in insulation requirements as well as being less liable to deliver a serious shock in case of accidents. From this it should not be implied that any form of careless hookup will suffice, but it does make things somewhat easier as regards the choice of plugs and cables, as well as reducing the risk of flashover in humid or damp conditions.

by Philip Watson

However, apart from making possible the use of electrolytics, the most important advantage of the low voltage tubes would appear to be their effect on the power supply. In place of the old arrangement of a low voltage battery, vibrator, transformer, and rectifier, it is now possible to substitute a dry battery having a voltage equal to the lamp voltage and to charge the capacitor directly from this.

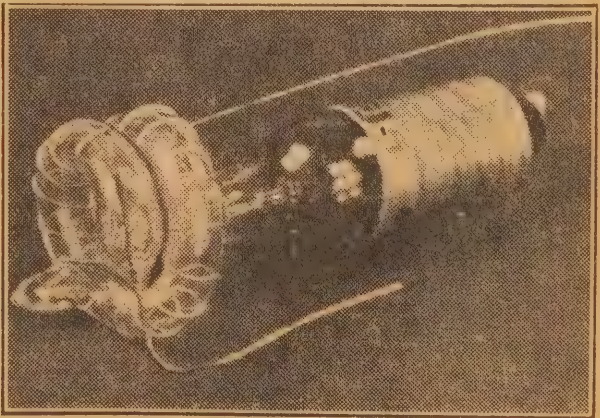
The two main advantages of such a scheme are: Simplification of equipment resulting in lower cost, and much improved electrical efficiency. In the old arrangement power was wasted in the vibrator (reed current), the transformer (iron and copper losses, which were often aggravated by the need to design for minimum weight), and the rectifier (internal resistance and other losses common to dry rectifiers).

These factors not only increased the battery drain, but also the charging time, and, as with the weight problem, it was sometimes necessary to strike a compromise in terms of light output which would permit a reasonably fast charging time. What may be regarded as a reasonable charging time depends largely on the user. To the amateur or professional doing ordinary routine work 15 seconds may not be excessive, whereas the Press photographer, who must get his pictures as they come, requires a new flash in no greater time than it takes him to change a film.

FAST CHARGING TIMES

With certain types of modern equipment it is possible to obtain charging times as low as two seconds, though it must be appreciated that the power involved has some bearing on this factor. Nevertheless, one imported commercial unit will charge in three to four seconds.

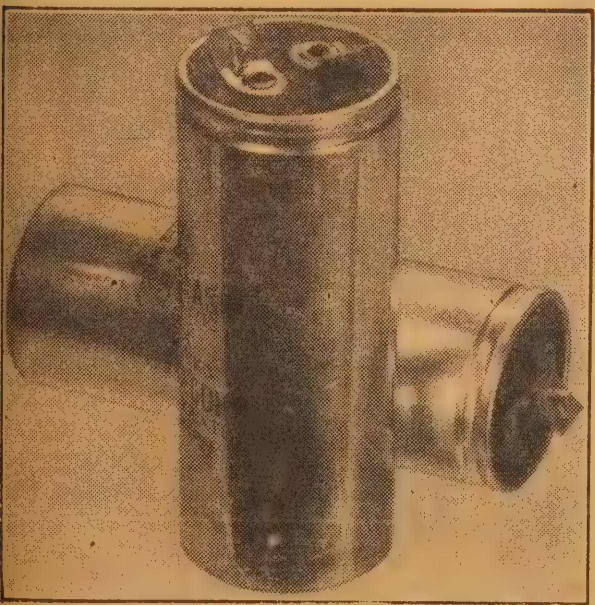
Another advantage of the higher electrical efficiency is the reduced standing current. For various reasons, including safety, it is usual to provide a bleed resistor across the main capacitor. This, together with the natural leakage of the electrolytic, causes the charge on the capacitor to slowly leak away. To make sure that the capacitor will remain charged until it is actually wanted it is necessary to apply the charging voltage right up until the time of the flash, and this involves a lot of waste power in the case of the vibrator system, due to the losses already mentioned.



A typical low voltage flash tube of the type we hope will be available on the Australian market soon. This is a 250 volt unit known as type SF15.

Where the capacitor is charged directly the only losses will be those of the bleed system and the capacitor, and in most cases these can be made quite small. Thus, it becomes possible to switch the unit on when work is commenced, and leave it switched on until it is fin-

(Continued on Page 10[illegible]



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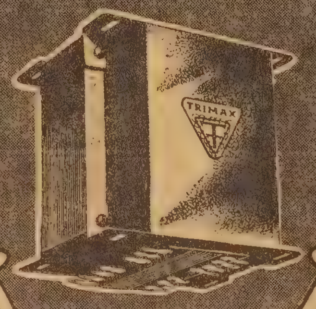

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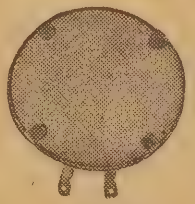

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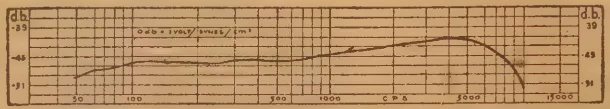

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TRADE REVIEWS AND RELEASES

NEW PUBLIC ADDRESS EQUIPMENT RELEASED BY AWA

Two interesting new items have recently been added to the AWA range of public address equipment. One is a self-contained power megaphone and the other is a compact public address amplifier.

KNOWN as the "Jericho", the power megaphone is not much larger than an ordinary voice megaphone, yet with its inbuilt amplifier unit, powered by 4-4½ volt torch batteries, it can be clearly heard over distances up to 500 yards.

The "Jericho" is free of external wiring and connections. A grip handle is provided, on which is mounted the ON/OFF switch—the only operational control—and the complete unit can be held to the mouth by one hand.

Amplification is achieved without the use of valves and the power supply consists of four torch batteries contained in the upper portion of the unit. These may be readily changed.

The entire equipment has been designed to meet the most arduous marine conditions.

When not in use, the power megaphone rests on its flare, which is protected by a rubber beading, or may be readily secured in any position by a simple form of bulkhead clip.

OPTIONAL FINISH

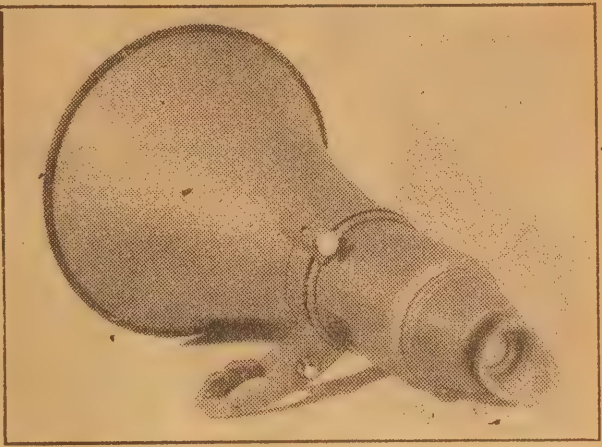
The unit can be supplied in a light grey crackle finish or anodised. Flare diameter is 11½in and weight with batteries 7lb 4oz. Power consumption is 300 milliamps.

"Jericho" is available ex stock and is quoted at £33/11/6, plus tax.

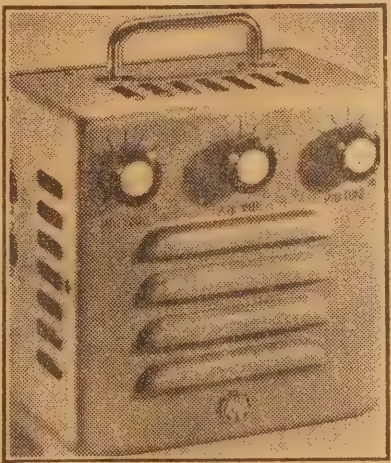
The amplifier, as illustrated, is housed in a metal carrying case measuring 6½ x 6½ x 4in and weighs 8½lb.

It has provision for one microphone channel (0.5 meg. input) and a high output pickup channel. About 10 db. of bass boost is available on this latter channel, if required.

On the output side, provision is made to match from one to four 600-ohm speakers, input and output connections being through 4-pin plugs.



The power megaphone, as shown on the right is eminently suited for marine applications where ordinary PA equipment would be too cumbersome. The new amplifier is shown below.



The amplifier is designed to give full output with less than 2 mV. RMS to the microphone channel and 0.35 V. RMS to the pickup channel. Excluding the effect of the optional bass boost and the treble-cut tone control, the response is quoted as within 2 db. from 50 cps to 8 Kc. Distortion is not greater than 3 pc total at full output.

Separate controls are provided for Mic. volume, pickup volume and pickup tone.

Valve complement is 6AV6, 12AX7, 6V6-GT, and 6X4. Price quoted for the amplifier is £26/0/6, plus tax.

NATIONAL BALLAST CHOKE

Newest addition to the National Transformer range of components is the 40-watt ballast choke illustrated below.

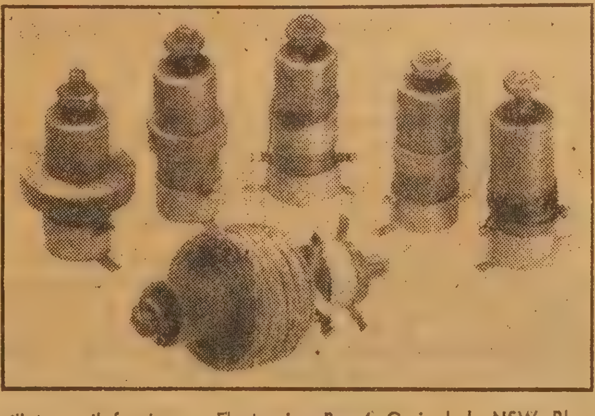
INTENDED for use with 40-watt fluorescent fittings, the choke type NB40/292 is completely enclosed in a metal shell and neatly finished in grey industrial lacquer.

Inside, the winding is varnished and potted to minimise hum and increase insulation resistance. The manufacturers claim low temperature rise, even under abnormal conditions where the starter may stick.

Measuring 4 9-16 x 2 13-16 x 1 1-16in, the ballast operates normally in conjunction with a 4 mfd. power factor correcting condenser. Agents are Wm. J McLellan and Co. Pty. Ltd., 126 Sussex St., Sydney.

TUNING COILS FOR OSCILLATORS

Readers who are planning to construct last month's service oscillator will be interested to learn that a set of five commercial coils is now available to suit the instrument. Suitably terminated and arranged for single-hole mounting, the coils will cover the complete range from 160Kc to 30 Mc. They can be used equally well with any Colpitts type oscillator.



Also shown is an oscillator coil for tape recorders. The manufacturers are Rex Electronics, Box 4, Caringbah, NSW. Phone LB6674.

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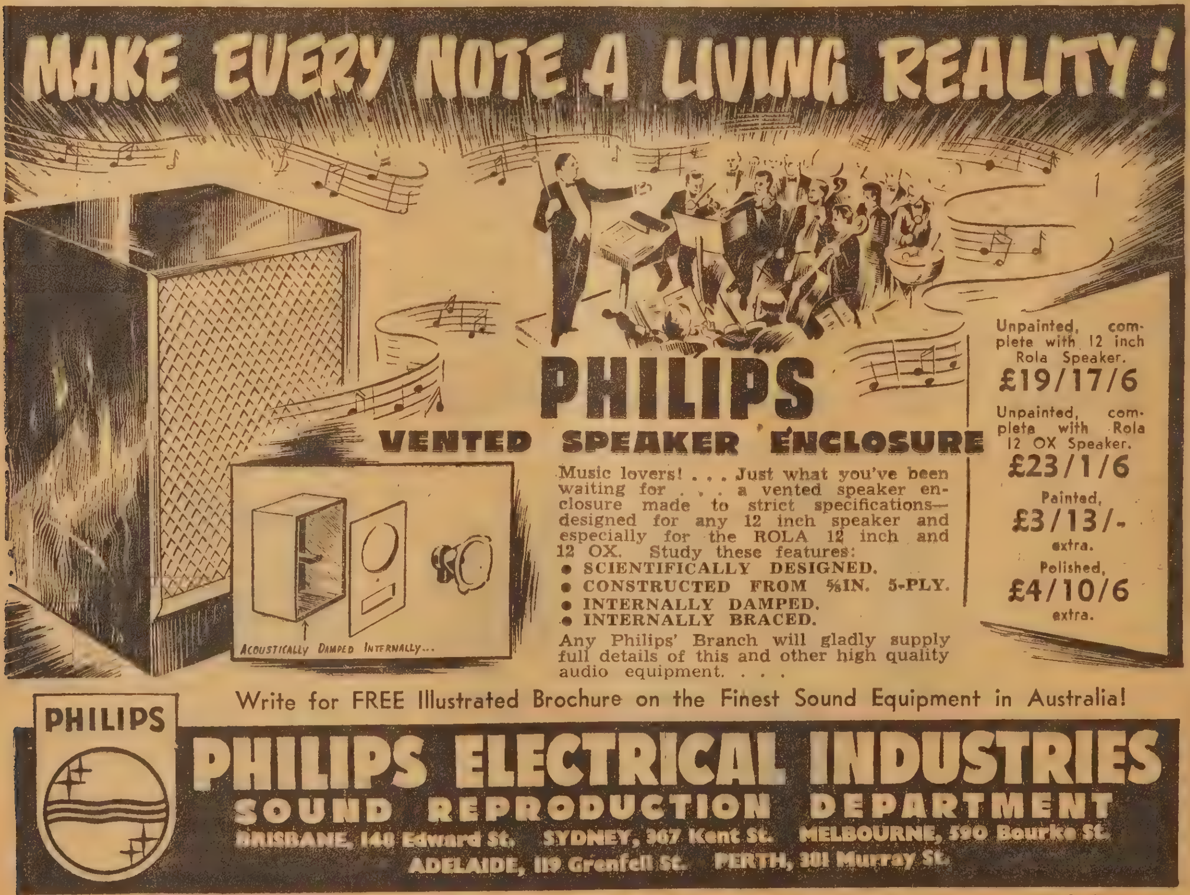
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PHILIPS ELECTRICAL INDUSTRIES
SOUND REPRODUCTION DEPARTMENT
BRISBANE, 148 Edward St. SYDNEY, 367 Kent St. MELBOURNE, 590 Bourke St.
ADELAIDE, 119 Grenfell St. PERTH, 381 Murray St.

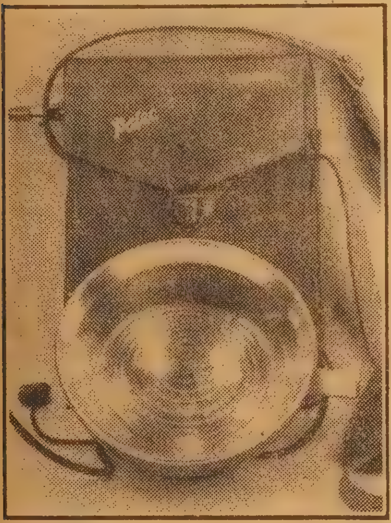
NEW PATON SPEEDFLASH

Messrs. Paton Electrical Pty. Ltd. have just released a new lightweight speedflash, Model G.100. The unit is pictured below.

USING a low voltage type flash tube, the model G.100 operates directly from a pair of 90-volt Minimax batteries. It has a charge build-up time of 5-7 seconds, and will deliver from 1000-1500 flashes per set of batteries, assuming this amount of use within the batteries' normal shelf life.

The unit measures approximately 8½ x 6 x 2½ inches overall and weighs 4½lb complete with batteries. An iridescent "Hammerglow" finish is applied to the chassis, which is housed in turn in an attractive leather case with rounded end and padded shoulder strap.

The Speedflash is supplied with a 6-inch aluminium reflector and diffuser, weighing 10oz complete. The tube has an expected life of 10,000 to 20,000 flashes, each of a duration approximating 1000 microseconds (1-1000th second).



The manufacturers quote a guide number of 100, based on the use of Kodak super XX film, processed in D72 developer 50 pc longer than normal. They regard this as more valuable than the now much-abused "joule" rating.

Supplies of the model G.100 Speedflash will be available through Kodaks and other photographic dealers.

AEGIS SPEAKER

FROM the Aegis Mfg. Co. Pty. Ltd. comes news of an Aegis Junior extension speaker, which retails at 50/-. It is similar in all respects to the Aegis De-Luxe extension unit except that it contains a 5in speaker.

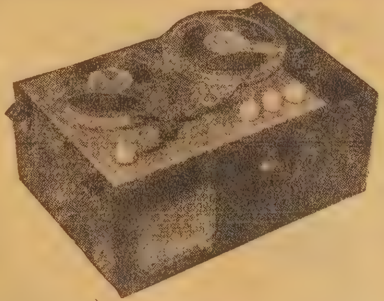
Printed and published by Associated Newspapers Ltd., at the registered office of the company, 60-70 Elizabeth Street, Sydney, NSW.

NOVA

DON'T WAIT FOR ANYTHING BETTER

'NOVATAPE' RECORDERS

ARE AS GOOD, AS ANYTHING IN TAPE-RECORDING WILL BE MADE IN YEARS TO COME.



'NOVATAPE' EQUIPMENT IS USED IN HUNDREDS OF HOMES, AND BY BROADCAST STATIONS AND IN RECORDING STUDIOS. **ASK THE EXPERTS,** THEY WILL TELL YOU THAT 'NOVATAPE' EQUIPMENT IS LEADING IN 1954 AS IT WAS BEFORE.

Kitset for Gramophone attachment	**£14** (heads extra)
Kitset for complete Tape-deck from	**£31** (heads extra)

NEW RELEASE:

TYPE 54 Recording Playback and Erase Heads, (half-track 50-14 Kc/c response) — **£4/19/6** each

EXCELLENT RESULTS AT 1 7/8" sec TAPE-SPEED.

Kitset for Converter from	**£9/18/-**
Complete Decks (assembled and tested) from	**£29**
Complete Recorders (including tape and mike) from	**95 Gns**

AFTER SALES SERVICE

MONEY BACK GUARANTEE

ALL PARTS DESCRIBED IN R. & H. AVAILABLE FROM "NOVATAPE". Other Tapedecks and Recorders (2 and 3 heads). details and prices on application.

PHOTOFLASH parts and kits as described in R. & H.

The only original WILLIAMSON TYPE OUTPUT TRANSFORMER IN AUSTRALIA TO ORIGINAL SPECIFICATIONS (WOUND ON IMPORTED, ENGLISH SUPER SILCOR 28A) (ALSO SUITABLE FOR LEAK AMPLIFIER AND "ULTRA-LINEAR") PRICE £9/1/0

ALL OTHER TRANSFORMERS TO OUR OR CUSTOMER'S SPECIFICATION.

BARGAIN: VARIABLE TRANSFORMER 9-16 volt 1.5 amp. can be used for toy motors, battery chargers, and festoon lights.

HURRY, ONLY A FEW LEFT

Brand New 25/- each and 3/6 postage

TERMS ON LOW DEPOSIT AND TIME PAYMENTS.

"NOVATAPE"
311 Sussex St.,
SYDNEY.
Phones: M2159.
M2350.

Open Saturday morning and week-day nights.

AGENTS: Vic.: J. CLANCY, Phone XA3580 after hours, S.A.: SCOTT SALES, 99 Currie St., Adelaide, LA1201 or JX6749.

CUT OUT HERE

2/54

Please send me without further obligation, details of Tape Recording equipment in particular.

....

NAME ....

ADDRESS ....

....

I enclose LARGE self-addressed envelope and 9d in stamps.

WALTHAM'S

OF SYDNEY AND MELBOURNE

Australia's Largest Mail-Order House For Ex-Government Radio, Electrical Equipment.

"WALTHAM DAN"
THE BARGAIN MAN

WALTHAM FOR GOVT. DISPOSALS
WALTHAM
DISPOSALS

Our Head Office, Mail Order Department and Retail Branch at 319-321 Swanston Street, Melbourne, Vic. Two doors from T.A.A. air terminus.

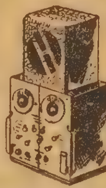
Our new Retail Branch and Mail Order Department at 96 Oxford Street, Sydney, N.S.W. which has been established for the convenience of our customers in New South Wales and Queensland.

WALTHAM TRADING Co

Our Branch at 393 Flinders Street, Melbourne, Vic., which is situated at the opposite end of the city, conveniently near a large city parking area and Flinders Street Railway Station.

AR8 RECEIVERS

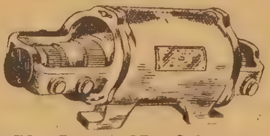
WORLD RANGE. AIR FORCE RADIO RECEIVERS



11 Valves. Capable of receiving stations throughout the world, including local, European and American stations, shipping, aircraft and weather bureau broadcasts. Excellent clear tone. Complete with loud speaker fitted in attractive leatherette case. Ready for use on 220 to 250v AC.

£34/17/6

GENEMOTORS



Type 72—Input 27v 3.6 amp; Output 250v 70Ma and 12.6v 2.6 amp **39/6**

Type DA-3A—Input 28v 10.5 amp; Output 300v 260Ma, 150v 10Ma, 14.5v 5 amp **29/6**

Type 31—Input 18v 12 amp; Output 7.2v 13 amp, 225v 110 Ma, **39/6**

Any of these models can be converted without re-wiring to operate fractional H.P. Motors on 240v AC.

RADIO COMPASS RECEIVERS

TYPE MN26

Ideal receiver for use in small craft or fishing vessels. 12v input. Frequency range 200 to 410 Kcs; 550 to 1200 Kcs; 2.9 to 6 Mcs. Complete with 12 valves and genemotor. Valve Line-up:—2-6J5, 2-6N7, 1-6F6, 1-6B8, 1-6I7, 5-6K7.

£24/17/6

MODULATING UNIT

TYPE 169

Containing Klystron tube, 3 neon stabilisers, 1 E.F.50, 2 half-wave selenium rectifiers, 1 5U4 rectifier, 1 CV.85, potentiometers, gears, resistors, high voltage condensers and transformer. **£4/19/6**

TRANSMITTER RECEIVER

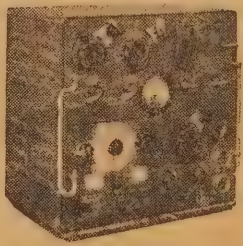
TYPE RT-34/APS-13

Frequency Modulated, approx. 450 Mc. Valve line-up:

9—6AG5	2—2D21
5—6J6	1—VR105

Also contains Dynamotor, input 27v. 1.5 amp., output 285v. 60 Ma. Price **£17/10/-**

AT5 TRANSMITTER

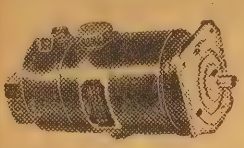


High Power Unit, using two 807 Valves. Covering 140 Kc to 20 megs. with provision for six crystals, and V.F.O. **£9/17/6**

Junction Box & Cables **£5/-/-**
Aerial Coupling Unit **£3/10/-**

FARM LIGHTING AND POWER EQUIPMENT

YOU CAN HAVE ALL MODERN ELECTRICAL APPLIANCES IN THE OUTBACK from your own simply constructed POWER PLANT. If you have a stationary engine these powerful, compact Aircraft Generators can be driven from same by a standard V Belt and Pulley, to charge a bank of batteries, to operate lights, power equipment and domestic appliances, irons, washing machines, refrigerators, etc.



Type P.1 30v 200 amp suitable for welding to 8 gauge rod, also heavy duty battery charging ... **£50**

GENERATORS

12v 500w Type A	£5
12v 500w Type L	£7/10/-
12v 750 Type LXZ	£11/15/-
12v 750w Tandem, Type RLX,	£5
24v 1500w Type KX	£9/17/6
24v 1000w Type K	£8/15/-
24v 500w Type E	£7/10/6
100v 600w Type LZ	£15

PULLEYS

3½ in single V	£1/15/-
3½ inch double V	£1/19/6

Splined to fit any of the above models.

Postage and Packing: 3/6. Interstate, 4/- (if supplied separately).

AUTOMATIC REGULATORS AND CUT-OUTS MADE BY BENDIX

24 volt and 30 volt	£3/10/-
12 volt	£4/19/6

Also suitable for tractor spare.

Postage and Packing, 5/-. Interstate, 6/-.

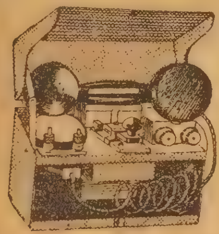
12 volt Cut-outs for 12v units 9/11

AMMETERS

50-0-50 moving coil	£2/10/-
30-0-30 moving coil	£1/15/-

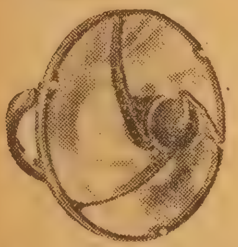
Postage and Packing: 3/6. Interstate, 4/-.

DON V TELEPHONES



Fresh shipment. Just landed. Ideal for communication in home, shed, workshop, office or factory. Fitted with buzzer call system, operated by two small 1½ volt radio batteries. Simply installed by connecting two wires from each unit. **PRICE £4/19/6** each, complete with batteries, 100yd reels **TWIN INSULATED WIRE** to suit, 27/6 per reel. 1 mile reels **SINGLE INSULATED WIRE**, £6/10/- per mile.

LANDING LAMP REFLECTORS

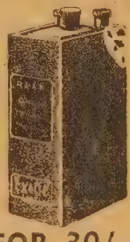


7 inch rhodium plated concave reflector, with forward mounting bracket, which can be adapted to take various lamp holder fittings. Suitable for floodlighting and photographic work.

PRICE 17/6

Postage and Packing: 4/-. Interstate: 5/-.

LIGHTWEIGHT (Wet) BATTERIES



2v 20 amp hours, as illustrated. In bakelite case. 7in x 3in x 2¼in. Weight 3¾lb. Ideal for flounder spearing.

THREE FOR 30/-

Packing: 5/-.

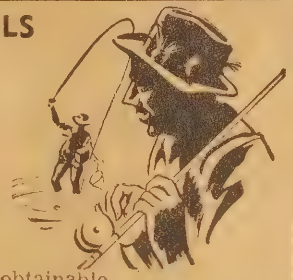
VALISE SLEEPING BAGS

(Officer type). Blanket lined. Waterproof canvas.

£3/10/-

Postage and Packing: 7/-. Interstate: 8/6.

TANK WHIP AERIALS FOR FISHING RODS

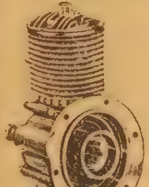


These Whip Aerials consist of two four-ft. sections of tempered tapered tubular spring steel, fitting neatly into each other, and weigh only 6 ozs., and the handyman can construct a strong flexible fishing rod, equal to the most expensive obtainable. Third section also available, and any number of these can be fitted consecutively on to the bottom of the two top sections to make any length required for radio, car or truck aerial.

PRICE, 15/- the two sections.

Additional lengths, 7/6 each. Freight and Packing, 5/-.

COMPRESSORS

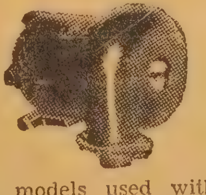


Aircraft type. Approximately 600 lbs. 1500 r.p.m. 2-stage. 1½ cubic feet per minute.

Price £5

Postage & Packing: 6/-; Interstate: 8/6.

BLOWER MOTORS

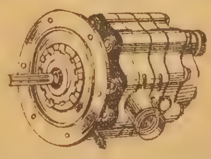


80v models used with a condenser can be operated from 240v AC **£2/10/-**

24v, ideal for ventilating systems for cars, etc. or forced draught for small forges **39/6**

Postage and Packing: 4/6. Interstate: 6/-.

HYDRAULIC PUMPS



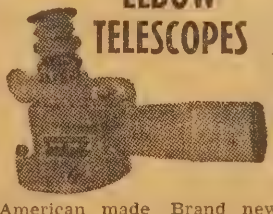
Hydraulic 3-stage 600lb per square inch £7/10/-

1200lb per sq. inch, this model ideally suitable for operating fork lifts, or other similar equipment £10/-/-

Post and Packing 6/-. Interstate 8/6.

Hydraulic Pump and 24v Motor combined, capacity 3½ gallons per minute £6/10/-

ELBOW TELESCOPES



American made Brand new. Approx. X8 magnification, complete with three built-in colour filters. Ideally suitable for rifle range, etc. **£7/10/-**

Post and Packing: 6/-. Interstate: 8/6.

"WALTHAM DAN" THE BARGAIN MAN

COMMAND RECEIVERS

Type BC453, 190 to 550 Kc., **£12/10/-**.
BC454, 3 to 6 Mc., **£7/10/-**.
BC455, 6 to 9.1 Mc., **£7/10/-**.

TRANSMITTERS

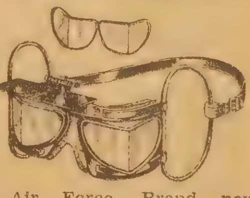
Type BC457, 4 to 5.3 Mc., **£7/10/-**.
BC458, 5.3 to 7 Mc., **£7/10/-**.
BC459, 7 to 9.1 Mc., **£7/10/-**.

TELEPHONES

Bell ringing type, battery operated, built in hand generator. Suitable for communications house to shed, etc. In polished wooden box with externally mounted bells. Can be used as desk or wall phones.

Price £6/10/-

FLYING GOGGLES

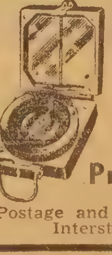


Ex-Air Force. Brand new. Mark IVB Goggles. Ideally suitable for motor cyclists, tractor and truck drivers, stokers. Complete with sun visor and inter-changeable anti-glare lenses.

Price 39/6 pair

Postage and Packing: 4/-. Interstate: 5/-.

HIKING COMPASSES

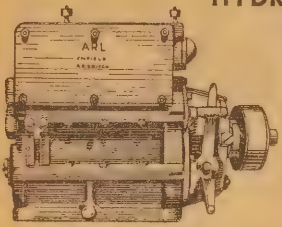


Practical compass, bakelite case 2¼in x 2¼in, thumb ring. Luminous markings for night use. Invaluable for hikers.

Price £1/9/6

Postage and Packing: 4/-. Interstate: 5/-.

SYDNEY SPECIALS (Available 96 OXFORD STREET Only)

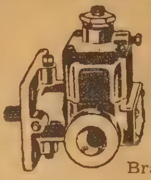


HYDRAULIC CONTROL UNITS

As used to traverse or elevate a Bofors gun, easily adaptable to general industrial use, such as driving a conveyor belt, or any unit that requires a variable or set speed, forward or reverse direction. This unit delivers 98 per cent efficiency at ALL revs. Complete with two Selsyn Control Motors. Approx. revs. on final drive 0-250 in either direction.

Price £10

FUEL PUMPS



Suitable for pumping any liquid. Stainless steel vanes. Approx 400 gallons per hour S/H but in good order.

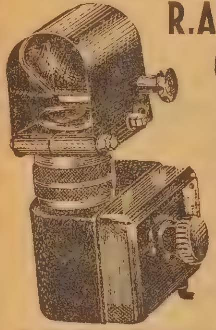
£2/10/0

Brand new.£3/10/0

Post & Pack 5/6; Interst. 7/-.

"WALTHAM DAN" THE BARGAIN MAN

R.A.A.F. Reflector GUN SIGHTS



Pilot type, containing normal magnification lenses, giving a magnification of approximately X6. Excellent light content. Diameter of lens 1¼ inches.. focal length 1-10/32 inches. . . , **17/6**

Post and Packing: 5/-. Interstate 6/-. Available Sydney Branch only.

TOOL BOXES

Sturdily built, with multi-partitions. Ideal for the workshop. Length 21 ins., width 16 ins., depth 5½ ins.

£3/0/0

TEMPERATURE GAUGES

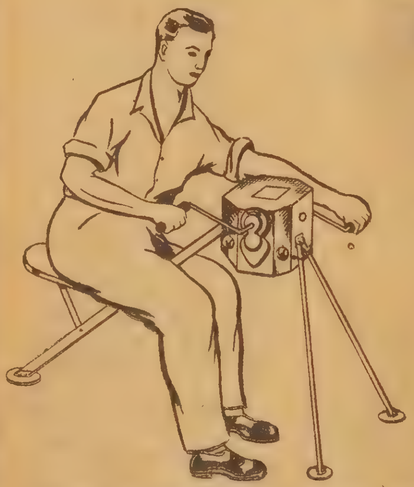
Suitable for Hot Water Systems. For measuring radiator temperature, complete with capillary tube. Size of dial 2¼ins., calibrated from 0 to 100 degrees centigrade.

PRICE £1/17/6

Post & Packing 5/-. Interstate 6/-.

Available Sydney Branch only.

MELBOURNE SPECIALS (AVAILABLE 319-321 SWANSTON ST. 393 FLINDERS ST. ONLY)



BOURKE GENERATORS

American Type GN-35

Hand crank Generators. Ideally suitable for conversion to wind battery charger. Output 10 volt at 1.25 amps; also 400 volt at .07 amps.

Price £2/10/0

These Generators can also be used to operate as 6 or 12v electric motors without alterations. Final drive through reduction gear is approx. 200 r.p.m. drawing 5 amps. approx. Ideally suitable as a driving motor for trawling in small boats on rivers or lakes, duck shooting, etc.

OXYGEN CYLINDERS

R.A.A.F. Aircraft Type. Non-shatterable stainless steel, light weight. Diameter 12in. Length 24in. Capacity 2100 cubic in. Pressure 650lb. Weight 18lb. **PRICE £5**

Available Melbourne Branch only.

VALVES

BRAND NEW IN ORIGINAL CARTOONS

1H6	7/6
1K7	10/6
6AC7	15/-
6B8	15/-
6F6	12/6
2051	22/6
6K6G	12/6
6L7	12/6
807	25/-
813	60/-
830B	60/-
VR150/30	22/6
954	7/11
12A6	12/6

2050 ... ... 22/6

This valve is suitable for use with Photo Cell Relay Unit, as per June, 1953, issue of Radio and Hobbies.

The above Valves only obtainable from Melbourne Branch.

TELEPHONE RELAY PANELS

Brand new in wooden transit box. Panel contains full wave copper oxide rectifier, two phone jacks, one relay and one bayonet contact lamp holder and bezel.

PRICE 12/6

Post Free all States.

MAGNAVOX

Two valve, inter-phone amplifiers. Complete with filter, choke and output transformer. **£3/10/-**

WIRE!!

Heavy duty, 90 amp. Suitable for home lighting plants, etc. 4 B & S Gauge. Voltage drop 1.06 volt per 1000 ft. at 32 volt 20 amps.

2/6 per yard

VITA VOX

Public Address Loud Speaker Units. Voice Coil 12.5 ohms DC resistance. Brand new.

£12/10/0

RADIO TRANSCEIVER AND INDICATOR UNIT

VHF approx. 180 Mcs.

Type 1045. Valve line-up in Transceiver: 2—RL18, 1—VR135, 1—5V4, 1—Ea50, 1—RL37, 6—EF50, 1—6SN7, 1—GL2050 (Thyratron), 2—VR150/30 (Voltage Regulators), 1—884 (Gas Triode). This unit also contains a motor-driven Selector Switch, two superbly-designed Polystyrene six-position rotary Coil Turrets, and an I.F. Transformer strip ideally suitable for use with Television. Band width 10Mc. Indicator Unit, Type 1047, Valve line-up: 7—Ef50, 1—879, 1—VR54. Also contains a 3,000 type relay 2.0000 ohms, ten assorted Potentiometers, a two-bank Ceramic Wafer Switch, and an Illuminated scale (5BP1 tube and shield not included). These two units are brand new, and are packed together in their original packing cases.

Price £21/10/- the two

Transceiver ..... £15/-/- } if supplied
Indicator Unit .. £7/10/- } separately.

Bendix Radio Azimuth Circle

Loop Aerial Controls

Type MN.22A

PRICE 35/-

Postage and Packing: 4/9. Interstate: 6/-.

Micro Switches

Micro Switches are compact precision snap switches, designed to be operated by light pressure—and/or small movements. They are robust and reliable switches, capable of switching heavy currents, and of being operated a million or more times, at least.

TYPICAL USES: As a Burglar Alarm, concealed mounting can be arranged—operation by the sash-cords — or weights is typically good practice. The SLIGHTEST window movement can operate the Switch.

3 FOR 22/6

Post Free.

Economy Meters

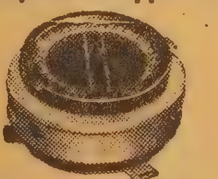
Get the maximum performance from your car at minimum cost of petrol.

Brand new precision made aircraft manifold pressure gauges made by Bendix of America recalibrated for use in any make of car or truck. Simply instal by attaching a flexible tube to the suction windscreen wiper coupling or direct to the intake manifold. This instrument when installed in your car will tell you immediately when you are giving the engine more petrol than is required to do the amount of work it is doing.

PRICE 49/6

Postage and Packing 6/-.

Compasses Type P4



7in dia. 3½in deep. Liquid filled, adjustable azimuth circle. Reconditioned as new. £2/10/-.

Type P.8. Similar in design to above. 5½in x 2½in deep.

PRICE 45/-

VACUUM PUMPS

MADE BY PESCO

Will build up pressure to 28in. approx. at 1000 r.p.m Will pump 7½ gals. per minute. Ideal for hydraulic systems, and many other uses.

Brand new £3/10/-

AIR FORCE COVERS

16ft. 6in. x 6ft., unbleached cotton and sateen. White centre with 23 inch wide black border. Ideally suitable for car covers, dust sheets, painters' drop sheets, sun awnings, material also suitable for coat linings and children's light summer tunics, etc.

25/- each or two for 47/6

TRANSMITTER TUNING UNITS

Type TU10B
10,000 to 12,500 Kc., £2/10/-

Type TU9B
7700 to 10,000 Kc., £2/10/

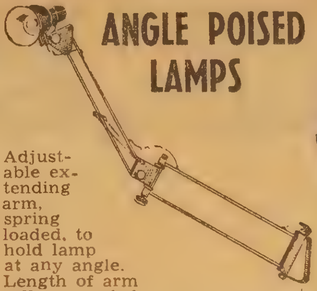
METERS
SPECIAL FOR THE RADIO AND ELECTRICAL ENTHUSIAST

One parcel containing three R.F., Amp or Milliamp Meters. Various ranges. All in good condition. Useful for converting and recalibrating.

PRICE 22/6

Post Free.

ANGLE POISED LAMPS



Adjustable extending arm, spring loaded, to hold lamp at any angle. Length of arm fully extended 36in. Ideal for work bench, students, architects draughtsmen. **£2/10/-**

Post and Packing: 5/6; Interstate, 7/-.

UHF MIDGET RECEIVERS

Two models. ZB1 Frequency. 234 to 258 Mcs and ZB3 Frequency, 340 to 580 Mcs. Can be operated from either 12 or 24v internal change-over switch. Manually tuned dials calibrated in frequency.

£4/19/6 each

PRISMATIC TELESCOPIC SIGHTS

Can be converted as rifle sight, surveyor's sighting telescope and many other uses where first-class lenses are required. Length 5in. Eye-piece lens 1in, front lens ⅞in, eye relief 3in. Weight 15ozs.

PRICE £3/10/-

Packing and Reg. Postage: 5/-. Interstate: 6/-.

COMMAND MODULATOR UNIT

TYPE BC456E

In new condition. Contains:

1—12J5
1—1625
1—VR.150/30
3—24v Relays.

£3/10/-

"WALTHAM DAN" THE BARGAIN MAN

RADAR RECEIVER AMERICAN TYPE CPR. 46 AAT

Containing Valves:

1—955	1—6AG7
3—956	1—83V
4—6AC7	1—2X2

and 24v Switching Motor.

PRICE £6/19/6

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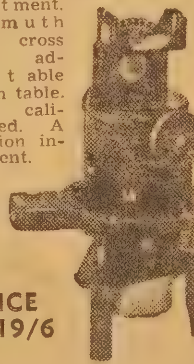

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OFF THE RECORD — NEWS & REVIEWS

There is no let-up in the flow of new records in the LP field. We can now say, I think, that the day of the 78 record for major works is gone for ever, and that the 33 rpm disc at present reigns supreme in this field.

By JOHN MOYLE

THERE appears to be no indication that the 45 speed will invade its territory. In Australia, at least, there is no great attempt to do much with the smaller discs, although time may change this as the presses catch up with the current demand.

The smaller local factories are working at full pressure to build up their catalogues, and EMI is now mixing increased imports with local pressings. Its stock of 45's will lie dormant for the time being, and there seems no hope of Australian release until the position alters.

In general quality, discs are much better than they were a year ago. It is only occasionally that a record comes along with a surface bad enough to require censure, although some of them still have background hum which cannot be blamed on the playback motors.

MODERATE RANGE

During the next 12 months I hope to see a general improvement in recorded range. This doesn't apply to all records, but the tendency to play safe is taking the bite from otherwise fine discs. Some of the best examples show that, with care, distortion even at the record centre can be controlled, and some of the smaller companies are showing marked improvement in this regard.

Our general listening standards have soared out of all recognition, and records which once we would have hailed with joy now serve merely to make up good average quality. The highlights are fewer than I would like, and they will be harder to reach the better our results become. Really good records must pass the most searching examination today, and the slightest flaw of any kind stands out in deadly relief.

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All this makes reviewing more and more difficult. One must spend hours listening and comparing to do justice to all. Maybe it's a tribute to record makers that they manage to make the job so interesting as one searches for cleaner and better music.

Here are some of the records I have played this month:

BRAHMS—String Quartet No. 1 in C Minor, Opus 51, No. 1, played by the Vegh Quartet. Decca LXT2710.

This record is something of a rarity, for we seldom hear a Brahms string quartet, of which there appear to be only three. His allegiance to the piano gave it an almost automatic appearance in his chamber music, and it seems almost strange to hear Brahms without it.

It is a fine and significant work, but I agree with other reviewers that there is more to the music than the players are able to find. It is new to me, but after three playings one begins to dig a little more deeply into it, and wish for a rather more intimate touch, particularly in the second movement; There are two or three other combinations whose version I would dearly love to hear for comparison. Somehow, I think the tempo of our times is apparent more in quartet playing than elsewhere in music. Few LP records can compare in musical worth with some of the fine 78 issues of the past.

"FORWARD" QUALITY

All this is mere opinion, however, and maybe it would be wise to leave it there. The recording itself isn't at all bad, with a particularly quiet background made the more so by a brand new pressing. It is rather forward, and I liked it best played at moderate volume.

Don't miss hearing it if you get the chance, as it should be available quite soon.

BEETHOVEN—Symphony No. 2 in D Major, Opus 36, played by the Vienna Philharmonic Orchestra, conducted by Carl Schuricht. Decca LXT2724.

A very good all-round performance of the hardest of all Beethoven's symphonies to make really convincing. I often wonder why the Sydney Symphony Orchestra chose it among their first efforts, and was rather sorry I was not able to extract an LP version of their effort from my friends at EMI for comparison. Judging from the 78 rpm issue, however, it would seem that the Vienna players approach the task with more assurance — they seem less afraid of it, and play without that touch of self-consciousness which is only to be expected of our own orchestra, whose experience in this field is much more restricted.

There is a colossal jump in Beethoven's development between the second and third symphonies — perhaps greater than anywhere else. This one is reminiscent both of the past and the future, but it doesn't quite fit into either. Perhaps that is why it's one of the least popular, although for many reasons it cannot be ignored.

IN BRIEF

The first movement is taken at a steady pace, but with plenty of bite and precision. The second shows a nicely graded pianissimo and fine balance, both maintained with admirable consistency. The third is bright, but a little muddy here and there, and the fourth sustains the general tempo with perhaps a little too much top and bottom and some loss of clarity at the end.

The surface is smooth, the general frequency range fairly wide, and the general recording somewhat remote. Not an outstanding record, but very sound and pleasant to hear.

BEETHOVEN—Symphony No. 4 in B flat Major, played by the Vienna Philharmonic Orchestra conducted by Wilhelm Furtwangler. HMV ALP1059.

It isn't easy to assess this record, for musically it is something of a mixture. In my mind when I first heard it was the well-known Toscanini 78 version, and there is a great contrast almost from the first note. If your reactions are like mine you will be somewhat taken aback by the terrific variations in tempo insisted upon by Furtwangler, particularly in the first movement. Toscanini varies not a hair's breadth from the classic line, but in this record we seem to be moving from a semi-coma one moment to a horse-race the next. Some composers are fair game for this kind of thing, but Beethoven somehow doesn't seem to appreciate it.

PRECARIOUS HOLD

The second movement fares somewhat better, although there are times when the orchestra seems held together by a proverbial matchstick. This is perhaps the most intimate music Beethoven ever wrote and fortunately even Furtwangler isn't game to play many tricks with it. But it's a close thing.

The third movement to me seems anything but allegro vivace, being rather exposed in slow motion. Even the cover annotations agree that it is scherzo, but apparently Furtwangler didn't read them. The last movement is a little better, but Toscanini's version leaves it for dead. This comparative basis may not be altogether fair to a new release, and it's possible you won't feel so strongly about it.

The recording standard is adequate without being outstanding. The orchestra sounds big, but somewhat unhappy I thought. I have heard it in better form.

BRAHMS.—Symphony No. 4 in E Minor Opus 98, played by the NBC Symphony Orchestra conducted by Arturo Toscanini. HMV ALP1029.

This is a record which, without hesitation, I must advise everyone to buy. The Decca version conducted by Krips was one of the earliest LP records I acquired, and I have come back to it time and again as an old friend I'd not be without.

ALTOGETHER DIFFERENT

Indeed anything I say about this Toscanini record shouldn't be taken as adverse to the Decca, for it's a quite different piece of work. It is broader and quieter than this latest disc, less urgent in impact, more remote and benevolent. Toscanini on the other hand has brought a high powered machine to bear on mighty music, and the result is mighty too.

The symphony is one of the finest Brahms or any one else ever wrote. It has no great emotional complications — it is broadly written and easily absorbed. Each movement, as is typical of Brahms, seems to lead inevitably into the next in both mood and context and at the end we have a rare feeling of completion, fulfilment and well-being. Packed into those two sides is a superb example of sheer, beautiful music, masterly use of themes and rhythm, ending with a magnificent passacaglia in which the full stature of Brahms is revealed.

The performance is very difficult to fault—if you like this Toscanini approach to Brahms then it's hard to imagine a better one. It hits from the first bars in which we hear his perfectionist mind at work moulding each phrase, and an orchestra that answers with beautiful precision and flexibility.

The recording I think is the best of the Toscanini-Brahms symphonies I have reviewed lately. It has immense weight and body, and in this respect alone is infinitely more striking than the Krips version.

NO SURFACE FLAWS

It played for me without any noticeable flaw down to the last groove. It lacks extreme top response as compared with the best of today, but this isn't serious—there are no fireworks displays here, and the range is safe and perfectly adequate. The surface, too, contains no unpleasant surprises.

A beautiful record of beautiful music, unlikely to be surpassed for many a day.

MOUSSORGSKY.—Pictures at an Exhibition, played by the Concertgebouw Orchestra, Amsterdam, conducted by Antal Dorati. Philips A00607R.

This work is an example of how the LP record has popularised music to new kinds of people. As a concert piece it was played occasionally, and we more often heard it in its original form during a piano recital. But lately some remarkable recordings of Ravel's arrangement for orchestra have been released, and since then the "pictures" have been good for animated conversation in any gramophonic company.

I haven't heard all the versions which have been released and am not therefore in a position to make comparisons. But I'd rank this as one of the most successful Philips records of its kind, always good and often remarkably good. It isn't an extremely wide range disc and I can imagine more brilliance being extracted from it. But it is full and round the microphone hears all the instruments well as they say their several pieces, but is far enough away to avoid oppression in the extremely loud passages, with a couple of minor exceptions. It plays very cleanly from start to finish and will sound good on even wide range equipment. There is some particularly good bass and brass.

The surface noise is up to standard with no appreciable clicks.

DEBUSSY — La Mer and Iberia, played by the Philharmonic Symphony Orchestra of New York, conducted by Dimitri Mitropoulos. Philips AO1100L.

This is obviously a recording which comes to Philips through American Columbia, and one expects such a well-known combination to be worth hearing. I do not think the recording is a recent one, but it is good, nevertheless. La Mer, of course, is a set of descriptive pictures of the sea, and Iberia three Spanish "Images". Both are quite important works for the musical student interested in Debussy, and include some of his finest and most imaginative writing.

My only criticism is a possible lack of delicacy in the playing, particularly in La Mer. There is an element of mystery inseparable from Debussy, and I didn't always hear it. The music is given with imagination, roundness and romance, but the blue mist wasn't always there in the distance, even though the sounds themselves were still lovely.

GOOD PRESENCE

It isn't wide range recording, but it has good presence, excellent bass and plenty of inner clarity. The soloists are particularly good. No noticeable distortion at the centre, or elsewhere, for that matter. Surface satisfactory, and should play well on any equipment.

J. S. BACH—Brandenburg Concerto No. 3 in G Major, No. 5 in D Major, played by the London

(Continued on Page 111)

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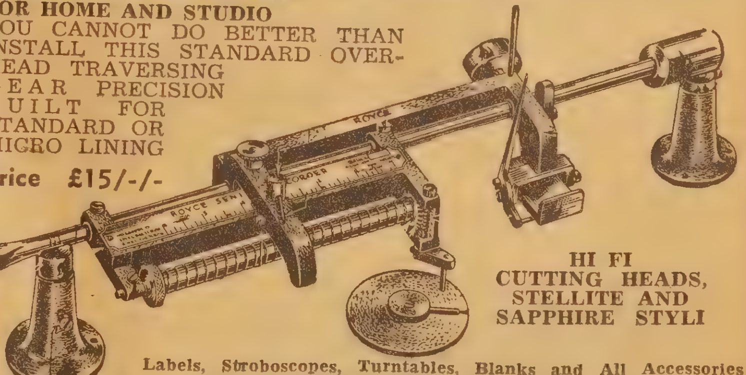

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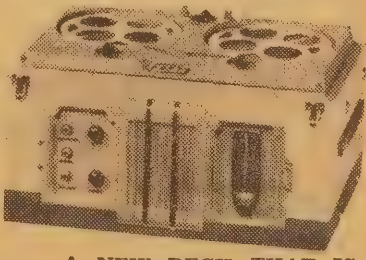

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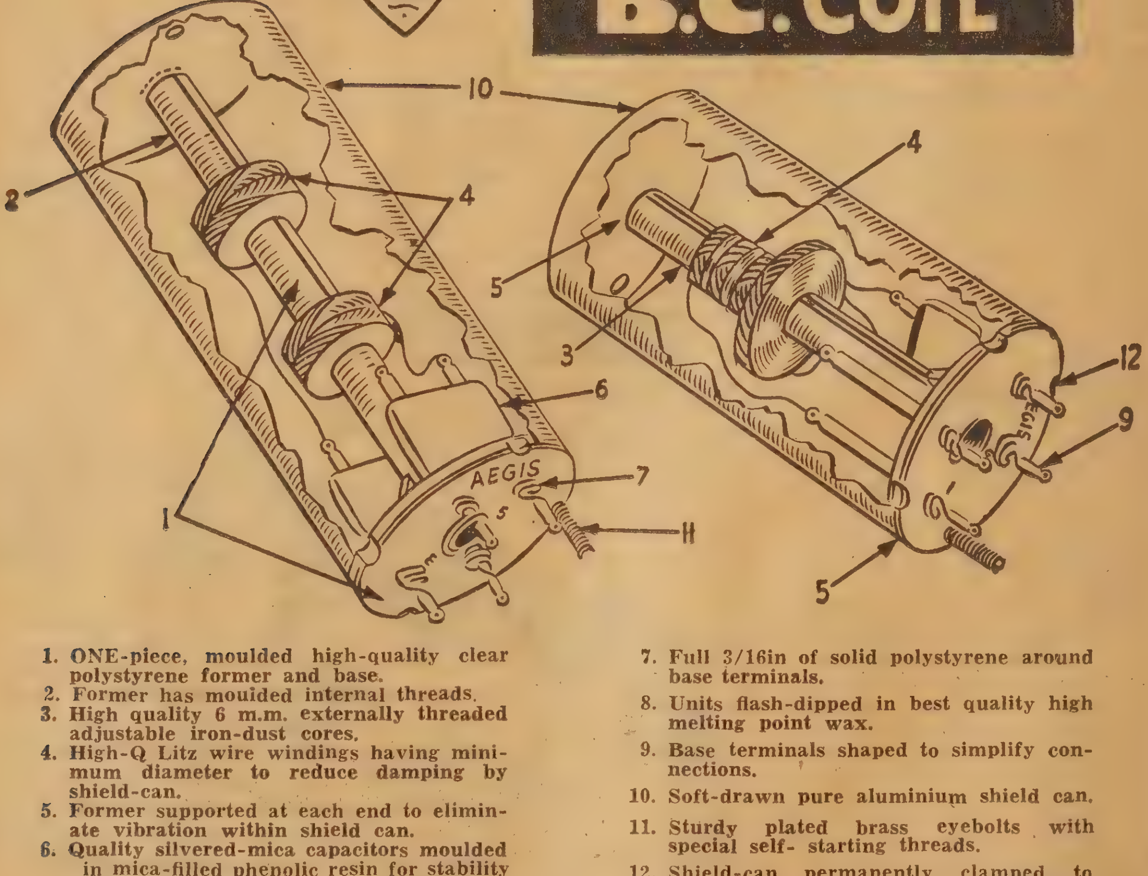

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LATEST RECORD NEWS FROM OVERSEAS

New Year issues in Engand have got away to an excellent start. All companies apparently have made a strenuous effort to be represented in the new releases, the EMI group alone being responsible for 40 new LP's.

BY DISCOBOLUS

THESE include a new Otello with Toscanini, a wide variety of chamber music, and the complete recording, on 10 discs, of the Casals Festivals of 1950 and 1951. These feature works by Bach and Mozart, played by such soloists as Isaac Stern, Rudolf Serkin, Myra Hess, Joseph Szigeti, and, of course, Casals himself.

HISTORIC INTEREST

These are of great historic interest, but as all the recording was done on location the quality falls short of the more usual studio productions. Sir Thomas Beecham appears with five new LP's—the Sibelius 1st Symphony, Beethoven's Eroica, Haydn's Drumroll and Surprise, the Mozart No. 38, and the Coq d'Or suite of Rimsky-Korsakov. Stravinsky conducts his Rite of Spring, and on another disc conducts and plays his own compositions, in one of which he is associated with Woody Herman and his orchestra.

Decca have 10 new records, including the second versions, for them, of the Beethoven 5th and 6th Symphonies, this time by Erich Kleiber with the Concertgebouw Orchestra, and works by Brahms (2nd Symphony and 1st Piano Concerto), Grieg, Bizet and Handel. Among their seven new L'Oiseau-Lyre discs are two by the Melbourne organist, John Eggington. On Telefunken there are 20 discs, involving three Beethoven Symphonies, and Dvorak's New World, by Schmidt-Isserstedt. Not to be left out of anything, they now have their own Pictures at an Exhibition.

SIX OPERAS

NIXA have added 30 Westminster, including six complete operas. In the one month, there are three recordings of Lohengrin, two Otello's, another Tosca, and Vox have a new Bach Mass in B Minor. HMV issued William Walton's recording of Belshazzar's Feast, and another is to appear any time now by Sir Adrian Boult, on NIXA. Both recordings feature Dennis Noble. Evidently NIXA are making recordings in England now for themselves as well as representing their American labels.

In the main, Decca are responsible for most of the brand-new performances in newly-released recordings. Most of NIXA is purely re-release of American records, and large numbers of the EMI discs were previously issued on 78-rpm sets. Decca, on the other hand, were not sufficiently established prior to LP to be able to transfer large numbers of 78's to microgroove, and most of their LP's are very recently recorded.

The American lists seem to be getting just a little smaller, most companies having already their fair share of the best-sellers. Columbia, nevertheless, have yet another Beethoven 9th, for under seven dollars the set. The coupling is the 8th Symphony, and this makes the fourth version by Columbia.

Something new, however, is the "Demonstration" record, now on sale by Urania, Westminster, Capitol and RCA Victor. These discs contain selections from the highest quality recordings issued by these companies. The RCA LP contains items ranging from Toscanini's Pines of Rome (which is the latest Hi-Fi Hit over there) to Perry Como.

WITH BOOKLET

Of those available, the Capitol is the most ambitious, as it comes complete with an illustrated booklet explaining to the record buyer what high quality reproduction means, and showing him what to listen for on the records. These are not test-discs and they do not contain large slices of frequency runs. They are supposed to show the public what can be got from modern equipment, presumably in the hope that he will buy more records and better equipment.

The Ferranti company have just added a new and interesting pick-up to the American market (although there has been no sign of it in England or elsewhere). The designer is Mr. Williamson, of amplifier fame. Very unusual in appearance — it looks like a snake ready to strike—it is a ribbon type, with plug-in heads. The moving part is of beryllium copper, and the stylus pressure is 3 grams. Resonance occurs at 3 cycles, and the response is flat to 20kc with measurable output to 100kc. The output is low, being only in the vicinity of 20 millivolts after the step-up transformer. An elliptical diamond stylus is used. A very low distortion factor is claimed.

English 45-rpm records are now on sale with an "optional" large centre hole. When bought, the disc has the small centre, and needs no adaptor for the standard turntable.

EASILY ADAPTED

At a later date, if the buyer purchases a player with the large centre spindle, all he has to do is push the centre of the record, and the whole middle falls out, leaving the large hole. There is nothing very remarkable about this, but it does mean that there is less chance of being left with a "swinger" due to an ill-fitting "spider" adaptor being used on a small spindle. EMI's 45's are now following the American trend, in that they are now also Extended-Play, one release having the Russian, Ludmilla Overture on one side, and the Grand March from Tannhauser on the other.

AN ultraviolet photometer for detecting extremely minute concentrations of dangerous gases in air has been developed by scientists of the Du Pont company. The new instrument is 100 times as sensitive as the human eye, and can detect changes as small as 1 part in 10,000 in the light absorbed by gaseous mixtures.

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SHORT-WAVE NOTES BY ART CUSHEN

NEW QUARTERS FOR U.S. STATIONS

The "Voice of America" is to move to Washington DC, from New York in June, to new buildings and studios.

DURING June, the Voice of America will move from the old New York 19, location to Washington. It is part of the major move of the new United States Information Agency, under the direction of T. C. Streibert, a former board chairman of the Mutual Broadcasting System, America's largest network with over 500 affiliated stations, reports Broadcasting-Telecasting.

The New York studios, located at 224 West 57th Street, has been the home of the various United States Government broadcasting organisations from the wartime OWI (Office of War Information) to the present VOA (Voice of America). The OWI used many transmitters of Press Wireless to carry the broadcasts to Europe and the listeners in the Asian continent, and such calls as WKRD, WKTN, and WKTS were frequently heard from OWI transmitters. The build-up to the present Voice of America includes the leasing of all the short-wave transmitters which were operated privately before the war, and the building of several powerful transmitters in overseas countries.

HUGE STAFF

A staff of 900 on the payroll of the Voice of America in New York will be one of the major problems in the shift, and to find housing for them in Washington will occupy the attention of the director of his staff, as well as the shifting of the technical facilities. The USIA has now over 6500 employees, but not all of these are connected to the Voice of America, many others being located at information centres throughout the world, and costs the US taxpayer some £30-million.

The Voice of America's new Asian transmitters, located at Okinawa and Manila, are penetrating into Asia with stronger signals. The BBC report hearing the Okinawa medium wave signals in England in the late afternoons, while the short-wave transmitters are being received regularly. The area of coverage of the new VOA transmitters is expected to include over 11-million receivers on the Asian mainland. The VOA is now able to put strong signals during evening listening hours across Asia from both the East and West.

In the West the new 5-million dollar Munich transmitter, is using the same frequency as Radio Moscow and is reported to be rolling back the Russian signal, and so reaching millions of Russian listeners, who with receivers pre-tuned to the Moscow frequency, are receiving the Munich transmission instead.

The transmitters at Munich, which now include, long, medium, and short wave outlet, employ a staff of 43, and the cost of the operations is estimated at £150,000 a year.

FROM CAIRO

CAIRO'S Far East transmission, which was so well received on 17725Kc has made a frequency change to 15315Kc and provides us with a signal as good as on the former frequency. The transmission opens at 11 pm with a short English identification, and at 11 pm an English program is presented, this consists mainly of Arabic music, with a few western numbers, and at 11.30 pm news in English is read, and this, according to the announcer, is for listeners in India. Some side interference has been noted on the frequency from Berne (15305) and Melbourne (15320). The complete schedule is: 10 pm (Indonesian), 10.30 pm (Arabic) 11 pm (English), midnight (Arabic), 12.30 am (Urdu) and sign off 1 am. The other two Cairo frequencies received at good strength are on 11965Kc to sign off 5 5 pm. often plays western music, and the 9475Kc station, noted at 7 am with English news.

NOTES FOR THE NEXT ISSUE

Notes for the next issue close on February 6th, at 212 Earn Street Invercargill, N.Z. All times are Australian Eastern Standard.

FROM THE MONTH'S MAILBAG

COCW HAVANA, CUBA, confirms reception with a long letter in Spanis from Dr. Eduardo Corominas, Sub Director General, "Radio Reporte" Prad No. 53, Havana. COCW operates o 6330Kc from 9 pm to 3 pm next day, an relays broadcast band station CMV (550Kc), which is on a 24-hour a da schedule. COCW uses the power of 100 watts, and the transmitter is locate outside Havana at Guanabacos. COCW' program is unique, as it is composed o entirely news and commercial announcements, with the clock tick heard durin the broadcast as a background. Englis is also used during the broadcasts, identification being given each hour.

FLASHES FROM EVERYWHERE

ALL INDIA RADIO is providing excellent coverage of the present cricket matches between the Commonwealth team and India, the test games being covered on many frequencies. The period after tea, heard from 7.50 to 8.50 pm, is broadcast on 15380, 11850, 9550, and 4960Kc, the former being the only frequency heard. The pre-tea relay is best received on 17760Kc to sign off at 7.30 pm. While on the subject of cricket relays, listeners should keep an ear for the Cable and Wireless station at Bridgetown, Barbados, which only operates when relaying cricket and races. It should be in operation this month with the MCC v. West Indies matches. This station, ZNX32, operates on 7547Kc and is heard mainly from 6.30 to 7.30 am.

BBC RELAYS of the Voice of America have been noted on a frequency of 5980Kc at 6 am. This is a frequency which is new to us, signals here are good, some interference from Paris on the next fre-quncy, but the signal is one of the best at the 50 metre end of the band. This BBC relay carries the Voice of America programs at 6 am and is still in operation at 7.30 am, also using GWL (7210), GSU (7260). Other new BBC relays, which we have only heard in the past on BBC European services, but now with Voice of America relays are GWM (6090) and MCR (9760) which carry a program in Hungarian to close down at 5 am.

NEW YEAR'S DAY provided DX listeners with interesting listening from South and Central America, when stations in this area broadcast on unusually late schedules. The most interesting station heard at our location was YNWW "Radio Sport" located at Granada, Nicaragua, and operating on 7850Kc. YNWW was heard with a dance program to sign off at 5 pm with Nicaraguan National Anthem. OAX4T Lima, Peru, on 9562Kc, and YVKD (5050), YVLK (4970), YVKC (4890), YVNB (4820), YVMF (4800), in Venezuela, and HJEF (4760) Cali, Colombia were the best 60 metre signals in the late afternoon.

SAUDI-ARABIA Broadcasting Station, Djeddah, is operating on this new schedule according to World Radio Handbook Bulletin. In Arabic, 2-2.45 pm, 9-9.30 pm on 3990Kc (beamed north and south), 11650 (to Iraq), 11750 (Egypt), 11850 (Syria and Lebanon), 11950 (to east). 1.45-2.30, 3.10-4 am on 3990, 6100 (Syria, Lebanon), 6,75 (Egypt), 7120 (Iraq), 9650 (east). Broadcasts in Urdu 11-11.30 pm and Indonesia midnight-12.40 am on 3990, 11650, 11750, 11850, 11950Kcs. All transmitters use 3000W.

VOICE OF FREE CHINA, Taipeh, Taiwan, is at present being heard at good strength in the news session in English at 3.30 pm directed to North America. Signals are best on BED6 (11735), the broadcast also being carried on BED3 (15235). On Mondays a review of Press comment is heard after the news. The complete schedule is 2-5 pm to North America, with news in English at 2 pm and 3.30 pm, on 15235 and 11735Kc. To Japan, Korea, South East Asia and Australasia. 7.30-10 pm and to China, 10-2 am on BED7 (7130), BED6 (11735). The transmission to Europe, 5-7 am is broadcast o 11920Kc station BED4, English new being presented at 5.20-5.30 am.

HONDURAS has added a new station HRTL "Radio Tela" at Tela, which use the frequency of 6035Kc. Schedule i midnight-2 pm, according to airmai verification from the station, which shows transmission is not broadcast o Sundays. The period noon-1 pm is made up of American dance music, accordin to the International SW Club Bulletin Iran's Radio Teheran transmissions are carried on three frequencies to Europe including the use of the 3Mc band which is providing such good receptio in Europe from Delhi transmissions Teheran uses 3850, 6155 and 9680Kc i the transmission to Europe from 4 am t 6.30 am. The period 4-5.45 am include Western music, 7.45 am news in German 6 am news in Spanish and 6.15-6.30 am i English.

RADIO YUGOSLAVIA is operating o a new schedule from January 1 for the English news broadcasts, reports Swedish DXers Calling. The broadcasts are 10.30-10.45 am (7240, 9507), 2.30-2.45 am, 6.15-6.30 am, 7.45-8 am all on 6100 and 7200Kc The Yugoslav Central Amateur Station has moved to 7400Kc and broadcasts dail with from midnight to 2 am a progra of music. Reports are appreciated by Mr George Vukovich, 4 Vlajkoviceva St. Belgrade 2, Yugoslavia.

PHILIPPINE stations affiliated wit Alto Boadcasting System, Manila, the Philippine network which operates thei first TV station, has two short-wav transmitters in operation, as well as broadcast band stations, the key statio is DZAQ in Manila. The short-wav relays are DZI2 (9550) 2Kw which relay DZBC Manila, 7 am-2 am, and DZH (7280) 1Kw, relaying DZMC (Davao City 7 am-midnight.

RADIO PAKISTAN broadcasts are th subject of an inquiry from John Hamilton, Reservoir, Vic., who asks for som details on his station. Radio Pakista was formed after the partition of Indi recently, and the servicce operates fro Karachi, with 50Kw transmitters, an smaller relay stations in Dacca in Easter Pakistan using 7500W. Lahore also ha a short-wave station but this is use mainly for the relay of the local programs, with a 300W transmitter. Radi Pakistan estimates its listeners in it own country as 800,000. The short-wav service of Radio Pakistan is located a Radio Pakistan Headquarters, 71 Garde Rd., Karachi 3. Transmissions are beamed to Turkey, United Kingdom, Sout East Asia, East and South Afric Indonesia, Burma, Afganistan, Iran an a general Arabic broadcasts for Nea East listeners.

Radio Pakistan's present schedule is.— 2.15-3 pm (15335, 17750) South and Eas Africa; 7.45-9 pm (9645, 17770); Sout Asia; 9.30-10.15 pm (15335, 17770) Indon esia; 11.30 pm-12.15 am (15620) Burma 2-3 am, 3.15-4 am (6235, 7010) Afghanista Persia, Turkey; 4.10-4.30, 4.30-5.30 am (7010, 9645) Arabic; 5.45-6.30 am (701 6235) Turkish, 6.30-7.15 am (7010, 6235 English to United Kingdom; 11.15 am noon (11885, 15335) South East Asia.

THE HAM BANDS WITH BILL MOORE

Radio amateurs generally have considerable difficulty in keeping level with the rapid technical developments of radio. In many overseas countries, much time, unfortunately, is being spent in curing television interference.

QUITE often the fault has not been with the transmission, but rather in re-eiver design. Regulations have been aried to correct this position.

Television interference is still a major roblem as gauged from overseas amateur adio journals, and, despite considerable xperimental work on the subject, tations are still forced to cease opera-ion during TV transmission hours.

Here in Australia we should soon learn f findings of the special committee set p to decide the best system and organi-ation for Australian conditions. Until hen, overseas developments can be fol-owed with interest, but it should be some ears before the problem confronts ama-eurs in this country.

Perhaps the most interesting develop-ent overseas on the TVI front is the ecent decision of the GPO in Great ritain on the responsibilities of amateur adio operators causing TVI. It involves onsiderable relief to operators and is eviewed in the RSGB Bulletin.

For a number of years now, the RSGB ave been conferring with GPO authori-es in an endeavor, in cases where TVI auses were due to inherent features of eceiver design, the amateur should not e held responsible. The set-owner hould be required to make and pay for ny modifications to eliminate such in-erference.

If these changes are not made, the mateur should be allowed to operate s usual.

As a result of these negotiations, the PO has reviewed its policy in respect to nterference with sound and television eception.

They have decided that, to enable the adio industry to make the necessary ar-angements, the present policy shall be ontinued until September 30, 1954. After hat date the GPO will continue to ex-ect the amateur to suppress all har-onics outside his authorised bands.

ESUMES OPERATION

Once this is done, if the wanted signal good and the interference is due to he choice of the IF for the complainant's eceiver, or to the image response of the eceiver, the GPO will allow the amateur continue operating after an interval f one month from the date on which he cause of the trouble is notified to the omplainant by the post office.

The GPO does not feel justified in ap-lying the same arrangement automatic-lly where the interference is due to the ose proximity of the amateur trans-itter to the complainant's receiver. In he few cases likely to arise, the GPO ill look to the amateur to prevent the terference.

These new arrangements will be con-ned to areas where the signal the com-lainant is trying to receive is a good ne.

The GPO is at present reviewing the hole question of interference in fringe reas.

This is an extremely important change f policy, as previously in Great Britain, s in this country, in all cases of inter-erence by amateur stations, either BCI TVI, when this could not be cured ith the co-operation of the listener or iewer, the station was required to cease peration during hours of BC and TV ansmission.

The TVI position is becoming increas-gly complex in the US, due mainly to vo new features, firstly the conversion f current TV receivers to the newer HF bands by means of converters, and he proposed introduction of color tele-ision.

Channel strips are being inserted in the d-type receivers which, using dual conversion, are used on the UHF television band.

The first intermediate frequency used is close enough to the 144mc band to cause a complete disruption of the picture in quite a number of cases. The FCC has been asked by the ARRL to record that, in such cases, the fault is in the receiver design, and under current US regulations the rectification of such interference is a matter for the viewer.

The TV receiver for color is by necessity much more complex than one for monochrome TV reception. These receivers include the use of sub-carriers, and one frequency involved in the original design was 3580 kc/s.

The possibility of TVI, and ITV (interference from TV receiver), using this frequency was fully investigated by a joint committee representing the ARRL and manufacturing concerns

Both forms of interference were recorded during the extensive experiments conducted, but it was clearly shown that the solution lies in suitable receiver design. As the tests were carried out before the mass production of receivers for color, it will be possible to modify receiver design.

As the years pass by, and with the introduction of more complicated television techniques, interference problems will increase. This will also apply with the general introduction of more electronic equipment, but undoubtedly, as in the past, amateurs and their national societies will surmount such problems, and business on the bands will be continued as usual.

PLANS FOR ANNUAL FIELD DAY

The WIA's annual Australia-wide field event, when amateurs will venture forth to operate in the national field day, will be held in February.

Support for these days, originally conducted in 1936, has improved, but the event has never received the acclaim of overseas contests.

The following information covers the main rules for intending participants:—

The national field day will be held on Sunday, February 14, and will run for 12 hours from 0900 to 2100 hrs east.

Power is limited to 25 watts input to the final stage. A special section for fixed stations working portable stations is now incorporated, and a special multiplier will be used to encourage the use of low-powered equipment.

A portable station must not use power derived from mains, must be located within five miles from the home QTH, and not located in an occupied building.

No apparatus may be set up earlier than 24 hours before the commencement of the contest.

Any number of licensed operators may be used.

CW stations should call "CQ NFD", while telephony stations should call "CQ National Field Day".

The contest is divided into four sections, namely: Open, CW, telephony and fixed stations.

Logs should be forwarded to the Federal contest committee through the participant's division to reach Box 1734, GPO, Sydney, not later than March 12, 1954.

VK DISTRICTS

For the purpose of the contest, VK districts are listed as follows:—

VK2, VK3, VK4, VK5 (South Australia), VK5 (Northern Territory), VK6, VK9.

Serial numbers must be exchanged to record points. For CW contacts they should comprise the RST report plus the serial number of the contact, commencing anywhere between 001 and 100. The phone section number will comprise the RS report plus serial number of the contact.

Points will be awarded as follows:—

Portable Stations—

Contacts with fixed stations within the Commonwealth, 1 point.

For contacts with other portable stations within the same State, 2 points.

For contacts with stations in Asia, Oceania, or North America, 3 points.

For contacts with other countries other than included above, 5 points.

For contacts with other portable stations outside the competitor's own State, 10 points.

To encourage QRP operation, the total number of points scored will be divided by the power input in watts.

Fixed Stations—

For contacts with portable stations in the contest within the same State, 2 points.

With portable stations in the contest outside the State, 5 points.

Certificates will be awarded to the winners in the various sections.

The incorporation of home stations in the contest should assist greatly in increasing support for stations in the field.

The introduction of an adjustment of scoring in accordance with the power input in use should also encourage amateurs with lower power equipment to participate. The exact manner of future adjustments will be better judged at the completion of this year's contest.

MEMORIAL CONTEST

Propagation conditions on the 50 mc band during the 1954 Ross A. Hull Memorial Trophy contest were quite good. VR2CG and VR2CB of Fiji, and VK9DB and VK9FN of New Guinea, supplied the DX interest. It was reported that KG6AY was heard in Australia and contacted by a ZL2, but to date the QSO was not confirmed.

The old UHF gang were active, as usual. The contest allows the usual get-together of interstate amateurs—very often the only contact they make with one another during the year.

Some peculiar effects were noted at times. VK3's were beaming on Tasmania to contact VK2's, while VK2's in Newcastle beamed on Queensland to contact VK3's.

Between Christmas and the New Year holidays the band was open practically continuously to some part of Australia or New Zealand. The peak was during the last two days of the contest, Saturday, January 2, and Sunday, January 3. All States of Australia, districts of New Zealand, VR2 and VK9 could be contacted during the Sunday. VK6's did not fade out until 2230 hrs.

In NSW the VK6's were very consistent, the VK3's being rather scarce.

A record number of VK6/ZL contacts were recorded. During one period VK6BO contacted 30 successive ZL's over the 3500-mile path.

It would appear that if more CW was used during the contest, more QSO's would be recorded. It should be possible during periods when signals are fading in and out, and during poor openings, to make contact on CW. Often stations heard at S5 and S6 and not readable on phone would be readily contacted on the key.

Some excellent scores were recorded, and VK6BO, VK4BT and VK4NG should be well to the front.

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QSL BUREAUS CANADA, U.S.

QSL bureaus for Canada, USA and her erritories are listed hereunder, and comlete the list published last month. hese bureaus are conducted by the RRL and run by managers on a volunry basis, while the league covers the unning costs.

There is, however, no special service ARRL members as given by the WIA ureaus to members here.

Cards are only forwarded on the reeipt of a stamped and addressed envelope.

Cards for the call districts and terriries listed may be forwarded to the ddresses as follows:—

W1, K1—J. R. Baker, Jr., W1JOJ, Box 2, Ipswich, Mass.
W2, K2—H. W. Yahnel, W2SN, Lake v., Helmetta, NJ.
W3, K3—Jesse Bieberman, W3KT, Box , Philadelphia 5, Penn.
W4, K4—Thomas M. Moss, W4HYW, Box 4, Municipal Airport Branch, Atlanta, a.
W5, K5—Oren B. Gambill, W5W1, 2514 . Garrison, Tulsa 6, Okla.
W6, K6—Horace R. Greer, W6TI, 414 airmount St., Oakland, Calif.
W7, K7—Mary Ann Tatro, W7FWR, 513 . Central, Olympia, Wash.
W8, K8—Walter E. Musgrave, W8NGW, 94 E. 188th St., Cleveland 10, Ohio.
W9, K9—John F. Schneider, W9CFT, 1 W. Ross Av., Wausau, Wis.
W0, K0—Alva A. Smith, W0DMA, 238 ast Main St., Caledonia, Minn.
VE1—L. J. Fader, VE1FQ, 125 Henry t., Halifax, NS.
VE 2—Austin A. W. Smith, VE2UW, 64 Jeanne Mance, Montreal 8, Que.
VE3—W. Bert Knowles, VE3QB, Lanark, nt.
VE4—Len Cuff, VE4LC, 286 Rutland St., t. James, Man.
VE5—Fred Ward, VE5OP, 899 Conaught Av., Moose Jaw, Sask.
VE6—W. R. Savage, VE6EO, 329 15th St., orth Lethbridge, Alta.
VE7—H. R. Hough, VE7HR, 1330 Mitchell ., Victoria, BC.
VE8—W. L. Geary, VE8AW, Box 534, hitehorse, YT.
V0—Ernest Ash, V0IA, PO Box 8, St. hn's, Newfoundland.
KP4—E. W. Mayer, KP4KD, Box 1061, an Juan, PR.
KH6—Andy H. Fuchikami, KH6BA, 2543 amauu Dr., Honolulu, TH.
KL7—Box 73, Douglas, Alaska.

HF SECTION

The February meeting of the UHF ction of the NSW Division will be held February 5 at Science House, Sydney debate will be conducted, and a team three will confirm that NBFM is perior to amplitude modulation on the HF's.

The section will conduct a nocturnal /F hunt on Wednesday, February 17, e transmitter to be located in the burbs of Sydney.

Full details of the latter event will be nounced at the meeting and over K2WI.

The North Coast zone's annual convenon, held at Urunga, will be, as usual, n over the Easter holidays—April 16, , 18 and 19.

Zone officer Noel Hanson, VK2AHH, of empsey, will supply any early inforation on the event, and can be concted on 40 mx or at his home QTH

Bill Storer, VK2EG, ex-VK1BS, of eard Island, veteran operator, left for ustralian Antarctica with the Australian pedition on January 4. He will operate om the territory, using the callsign K1EG.

The Kista Dan will visit Heard Island d the French base at Kerguelen Island efore proceeding to the 2½-million uare miles of territory located 1800 iles south of Heard Island.

The equipment which Bill will use mprises a 100-watt transmitter and a per-Pro receiver.

Operating periods will vary, but the ation should be on the air in late ebruary.

VK1EG will count as a new country, d Bill should be very busy accomodating stations anxious to add another efix to their list. He promises to contact any station calling him.

Other operators who have gone south are Allan Hawker, VK3IB, who will operate from Macquarie Island, using the callsign VK1AC. Johnny Gore, VK2PG, and George Delahoy, VK3ADZ/VK5DY, will be located on Heard Island, using the calls VK1PG and VK1DY respectively.

Stuart Perry, WIBB, has produced the necessary cards for a 160-metre WAC, the first award of this class on record.

Cards from EKIAO Tangier, ZC4XP Cyprus, ZLIAH New Zealand, HCIJW Ecuador, KV4AA Virgin Islands, and EI9J Eire covered the six continents.

ZLIAH late in 1953 performed some notable feats on the 160-metre band when he conducted special tests with G6CJ and G6GM. He finally recorded a number of contacts with G6GM. This latter station also contacted ZL3RB.

This band has provided some excellent DX during the current sunspot minima. Previously, nobody dreamed of the possibility of WAC on the 160-metre band, a return to frequencies which amateurs explored around 30 years ago.

The band is not available for operation here in Australia except for emergency working. Prewar, when it was a normal amateur band, it was used very little, except during Fisk trophy contests.

250 COUNTRIES

The second station to reach the 250 countries' confirmed mark in the ARRL DXCC (CW) is W8HGW. Chas. Mellon, WIFH, still heads the list with 252 confirmed

The telephony section tallies have risen considerably, and Brazilian station PY2CK has tallied 228 countries, WIFH being second with 224 suitable confirmations.

To effect reductions in the general costs of field examinations for amateur radio licences in the US, the FCC intend in future to make novice and technical class licence examinations available by mail only.

Conditional class licence examinations, where applicants are located more than 50 miles from the quarterly examination point, will also be given by mail

During the summer, New Zealand stations have been contacting American stations on telephony on the 3.5 mc band. The band has been particularly good from 1900 to 2000 hrs NZ time Bruce, HRIBG, often runs S7, while occasional European phones were heard and. on occasions, contacted.

Following on the flood disaster of January, 1953, which ravaged the east coast of England and many parts of Holland, and despite no official recognition of the need of such service, a national emergency amateur radio communications service will be set up in England Stations on the east coast have been coopted, and 28 members of the RSGB have offered their services as key stations.

Two hundred others have expressed a wish to co-operate in any service that may be established.

Amateur radio work in such emergencies would justify any organisation that would be likely to effect public service.

The ARRL DX contest will be conducted in February and March. The following are the dates of the telephony and CW sections:—

Telephony: February 12 to 14, and again on March 12 to 14.

CW: February 26 to 28, and again on March 26 to 28.

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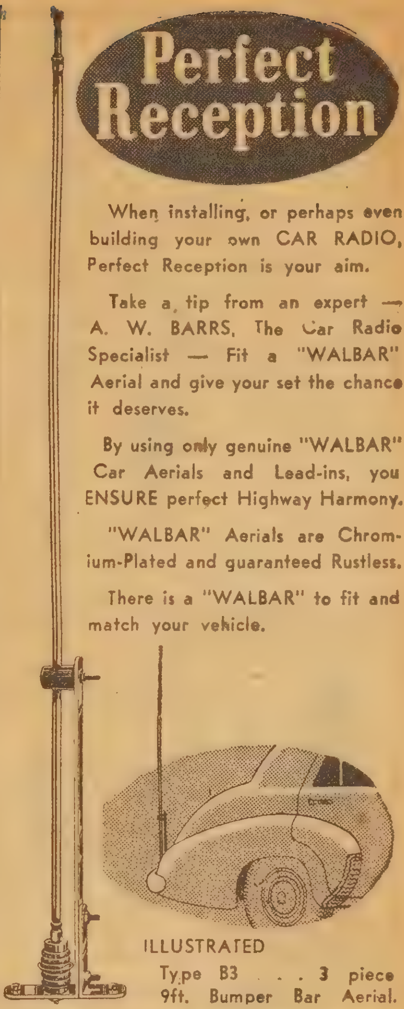

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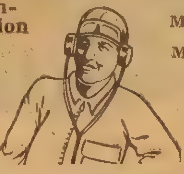

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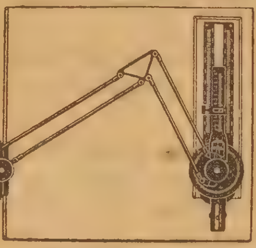

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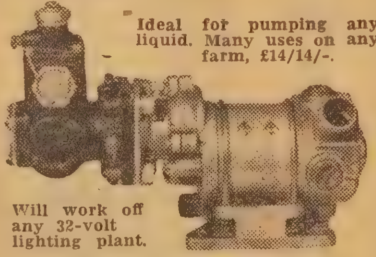

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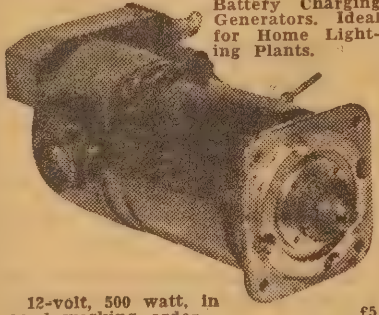

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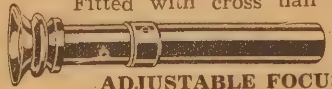

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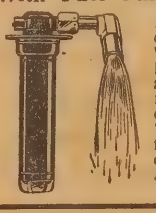

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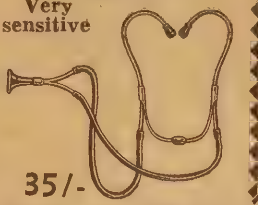

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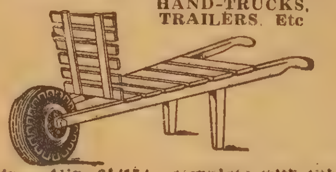

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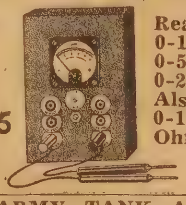
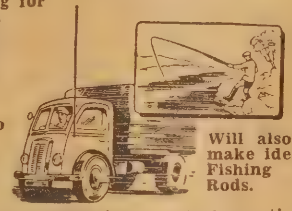
£5/17/6



Reads 0-10 Volts, 0-50 Volts, 0-250 Volts Also 0-10,000 Ohms.

STEEL ARMY TANK AERIAL RODS. WILL MAKE IDEAL RADIO AERIALS FOR CAR OR TRUCKS

Too long for postage. Advise nearest railway station.



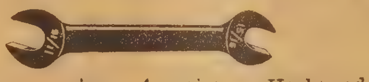
Base to suit Aerial, 9/6 each.

Will also make ideal Fishing Rods.

12ft long, 3 sections. Each section 4ft, 22/6. 8ft long, 2 sections, 15/-.

FOR MOTORIST

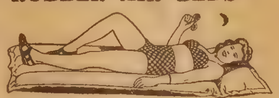
17/6 Special Offer **17/6**



2 genuine American Herbrand spanners, ¾ x 7-8, 1 1-16 x 15-16. 1 pair English diagonal cutters, 1 screwdriver.

LUCKY PURCHASE OF INFLATABLE RUBBER AIR BEDS

Ideal for Caravans, Cars, etc. Ideal for Hikers.



Take one to the beach. Will float in water £5/11/6.

AMERICAN ELGIN 8-DAY AIRCRAFT CLOCKS.

FIT TO YOUR CAR OR TRUCK.

£5/5/-

The name of Elgin is world renowned and made by the best manufacturer in America.

SURPLUS

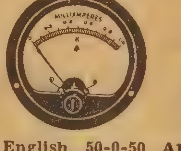
512 Elizabeth St., Melbourne, C.1.

'Phone: FJ5904. Just 4 doors

Mail Orders Carefully Packed

Please Add Freight or Postage

SPECIAL DISPOSALS METER OFFER.

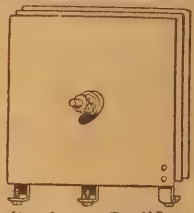


0-10 amp meters, AC-DC, 2¾in dial,	45/-
0-1 milliamp, 2½in dial	37/6
Weston 0-50 volt 0-100 amps combined M/coil,	£3/10/-
English 50-0-50 Ammeters, M/Coil	37/6
English 20-0-20 Ammeters, M/coil	37/6
English 0-20 Voltmeters, M/coil	25/-
English 0-40 Voltmeter, M/coil	25/-
English 0-300 AC-DC Voltmeters	55/-
English 0-5 Milliammeters, 2¼in	27/6
English 0-150 Milliammeters, 2¼in	30/-
English 0-25 Ammeters, 2½in, M/c	30/-
English 0-10 Ammeters, 2¼in dial, Moving Coil	45/-
English 0-30 Voltmeters, 2½in dial AC-DC	42/-
Eng. 0-40 Ammeters, 2¼in dial AC-DC	42/-
English 0-50 Ammeters, AC-DC	42/-
Eng. 0-3 Ammeters 2¼ dial, AC-DC	45/-
Eng. 0-150 Voltmeter, 3in Dial, Moving Coil	39/6
Eng. 0-500 Micro Ammeter M/coil	37/6
Eng. 0-150 Ammeters, 3½ Dial, AC-DC	75/-
Eng. 0-20 amps, 2in Dial, M/c	25/-
Eng. 0-1½ Milliamps, 2in Dial, M/c	19/6
Eng. 0-20 Milliamps, 2¾ dial, AC-DC	17/6
Eng. Multimeter, reads ohms and volts	35/-

BRAND NEW ENGLISH RECTIFIERS.

Make yourself a Battery Charger.

12v.	2 amp,	35/-
6v.	5 amp	50/-
12v.	5 amp.	79/6
12v.	3 amp.	45/-
6v.	2 amp.	24/6
6v.	4 amp.	45/-



Transformers to suit above Rectifiers, 2 amp, 37/6; 6 volt, 5 amp, 45/-; 12 volt, 5 amp, 55/-.

Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor.

32/6 SHEET.

Non-inflammable acetate sheet is recommended for all types of side curtain. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

AMERICAN VACUUM or AIR PUMP

Builds up air pressure to 20lb at 1000 R.P.M. develops up to 120lb of hydraulic pressure; will pump 7½ gallons S.A.E. oil or other liquids per minute Useful for spraying, milking, presses, oil burners, hydraulic systems. £3/15/-

STORES

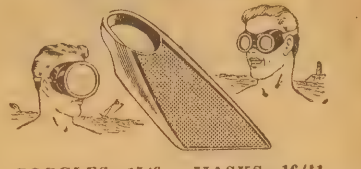
512 Elizabeth St., Melbourne, C.1.
from Victoria Street. 'Phone FJ5904
and Efficiently Despatched
Include State in Address

Stock and Die sets, ½in., ¾in. and 1in. water pipe, **£4/19/6.**

Small One-man Rubber Boats, ideal for spear-fishing **£6/4/6.**

IN FIRST CLASS ORDER DALTON COMPUTERS IDEAL FOR AERO CLUB.
45/-

UNDERWATER SWIMMING AIDS AS USED BY ARMY FROGMEN



GOGGLES, 15/6; MASKS, 16/11.
Fins, Large size, 8-10, 32/6; Med. size, 6 to 8, 32/6; Small size, 3-5 and 1 to 3, 24/6; Junior size, 18/6.

SPECIAL OFFERS

Generator Test Meters, 35-0-35 amp meters, 4¼in dial, **45/-**; 0-10 volt meters, 4¼in dial, **45/-**. Loading Resistors can be supplied to make meter read 10.20 at **12/6.** Medical Scalpels, many uses, photographers, etc., **6/6.** Shaded Pole induction Motors, made by Hoover of England, 230 volts, AC. Ideal for Projectors, Tape Recorders, Fans etc., **£4/19/6.** Inspection Mirrors, ideal for Mechanics, **5/9.** Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, **39/6.** 230 volts input. Low pressure Spray Guns, **39/6.** Army Steel Tow Ropes with looped ends, **17/6.** Army Tripods for photographic work, levels, etc., 41in long, **22/6.** SAE or Whitworth Spanners Sets, open one end, ring the other, **25/-**, 6 spanners to set. English Hair Clippers, first-grade quality, **17/6** pr. SAE open end Spanners, 6 to set, **24/6.** Whitworth, 4 to set, **18/6.** 2½in Paint Brushes set in rubber, special price **10/6.** Brand new 7-8in Spark Plugs, suit most old type cars, **2/6** ea. Brand new RAAF Life Jackets, kapok filled, **27/6.** 4in Calipers, inside and outside, **5/6.** Parabolic, Reflector Mirrors, 3½in **15/-.** 10½in, **39/6.** Build yourself a spotlight or for photographic work. Bosch Electric Windscreen Wipers, **£4/18/6.** Steel Tool Boxes, complete with lift-out tray, **32/6.** Best quality English Carpenters' Saws; 4, 5 6, 7, 8 and 10 point, **30/-.** Swiss Music Box Units, can be fitted into any box. Make yourself a Music Box, **30/-.** Many tunes available, including The Harry Lime Theme, The Merry Widow One Enchanted Evening, etc.

Army slouch hats, all sizes	22/6
American type G.I. caps	7/6
Khaki berets, leather bound	5/9
Water Bottles, complete	4/6
Best quality bib and brace overalls, navy or khaki	29/11 pr.
Boiler suits, navy or khaki,	51/6
American gaiters	3/6 pr.
Australian gaiters . .	5/6 pr.
All wool khaki socks	7/6 pr.
All wool army blankets	37/6
Heavy duty army boots	39/6 pr.
Jungle green herringbone self-support trousers	39/6 pr.
Army jungle green shirts	23/6
Khaki shirts	22/6
Army Great Coats	50/-

24-volt motor and hydraulic pump, capacity 3½ gals. per minute £3/15/-.

Automatic actuators with 24-volt motor geared with telescopic shaft 400 r.p.m, can be used as fence post borer, etc., 55/-.

Hydraulic pumps, 1200 p.s.i., 8 1-3 gal. per min., £18/18/-. 5 gal, per min., £7/10/-.

At last! The spotlight you have been waiting for.

63/6

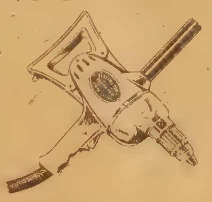
Complete with flex and switch.

Fitted with genuine American sealed beam 6-volt globes. No motorist or boat owner should be without one.

Ideal for Fox or Rabbit Shooting.

LUCKY PURCHASE. A FEW ONLY ½in 230 VOLT ELECTRIC DRILLS

English Wolf £25/6/-

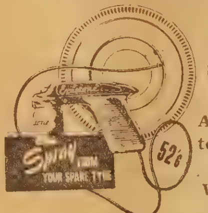


Black and Decker £22/16/-

BE EARLY THESE WON'T LAST LONG.

Genuine American hand operated Klaxon Horns. Ideal for trucks, factories, boats, etc. Brand new. £4/4/-.

SPRAY YOUR CAR, TOYS, HOBBIES, FURNITURE


Spray from your spare tyre
52/6

52/6

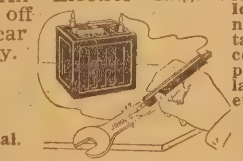
Spray from your Spare Tyre

An Ideal Tool for touching up damaged paintwork. Will spray Lacquer, Paint, Enamel.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.

Engraves anything in metal.



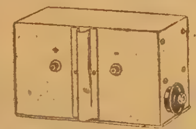
Ideal for name tags, dog collars, plant labels, etc.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.

COMPLETE BATTERY CHARGER

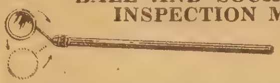
Fitted with Brand New English Selenium Rectifier.



Works off 230v. Household supply.

Charges any battery, 6 volts at 4 amps. £6/15/- complete. Also available, 6 or 12 volt Chargers combined. Charge 2 amps, £7/15/-. Brand new 6 volt, 2 amp Chargers, complete, £5/2/6.

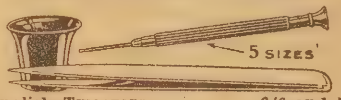
BALL AND SOCKET INSPECTION MIRRORS



8/9 each

Ideal for mechanics, radio repairs, dentists, etc.

WATCHMAKERS AND INSTRUMENT MAKERS



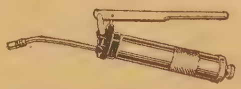
English Tweezers	**6/6 and 5/6**
Eyeglasses	**6/6 and 8/6**
Extra strong double lens Eyeglasses,	**15/-**
SCREWDRIVERS, set of 5	**13/9**

ENGLISH ARMY SPOTLIGHTS

IDEAL
FOR
SHOOTING.
FIT ONE
TO YOUR
CAR.

6-volt 37/6 12-volt 25/-
Fitted with Mirror Reflector.

BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6.



59/6

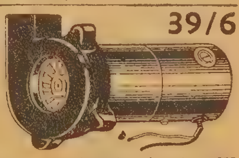
Ideal for all types of Trucks, Tractors or Cars. 7500 lbs pressure.

45/-
COMPLETE

Professional Magnifier with Stand and Extension Arm. Useful Doctors, Painters, Mechanics, Engineers. Photographers.

English Motor and Blower, 24 volts.

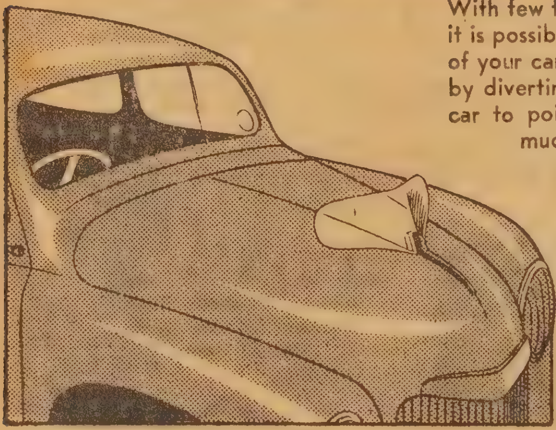
39/6



Will work off any Lighting Plant.

Larger size also available that will work off 12 or 24 volts £3/15/-.

MAKE THIS PLASTIC DEFLECTOR



With few tools, average skill, and a piece of 3/16in Perspex, 10½in x 4½in, it is possible to make quite a professional-looking deflector for the bonnet of your car. This useful accessory assists in keeping the windscreen clean by diverting the stream of air caused by the forward movement of the car to points beyond the area of the windscreen, and carries with it mud and flies which would otherwise settle on the screen.

☆

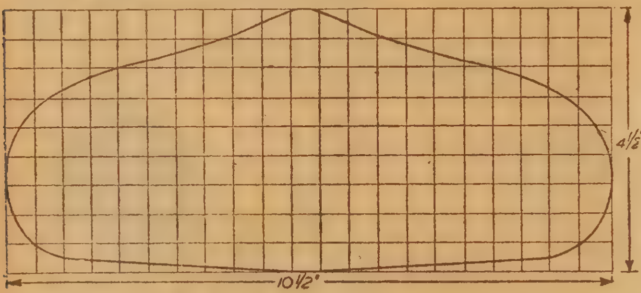
By C. T. MACKLIN

☆

THE angle to which the deflector is shaped largely depends upon the distance of its fixing point from the windscreen, the longer distances having a more acute bend. With a fixing point of 3ft. 8in. the following type has proved successful, but it will be readily seen how the actual shape can be adapted to suit different conditions.

The shape is first set out on the backing paper on the sheet of perspex (Fig. 1) and waste removed with a coping saw. The edges should be cleaned and polished before removing the backing paper.

Fig. 1 (below). How to mark out the shape.



A former should be made upon which the softened perspex may be shaped. This can be of wood or clay, as shown in Fig. 2.

A spadeful of clay from which stones have been removed is excellent as it can easily be rolled to a slab 1¾in. thick, after which the waste clay in the centre is removed with a hacksaw blade. The same tool is afterward used to make a smooth surface.

The clay should be allowed to harden before shaping the perspex.

Alternatively, blocks of softwood can be shaped and fixed to the baseboard. This makes a good job, but perhaps, may be too permanent for merely one shaping.

Having prepared the mould with smooth surfaces the piece of flat perspex is then softened in boiling water or, preferably, in a gas or electric oven set at a low temperature.

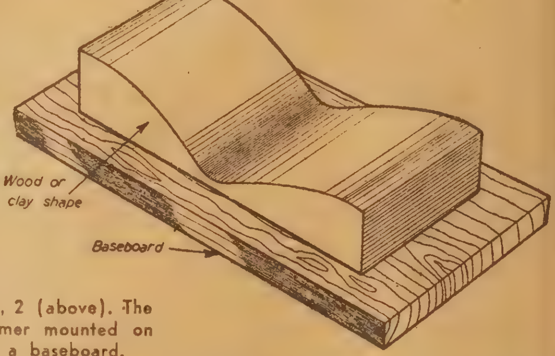


Fig. 2 (above). The former mounted on a baseboard.

For those with no experience in handling this material, first soften one of the waste corners from the original sheet so as to get some idea of the length of time required to achieve plasticity.

Plasticised perspex is pliable at 100 deg. to 110 deg. centigrade, and excessive heat will cause small blisters. It is quite easy to open the oven door to test for softness, and this should be done after two minutes.

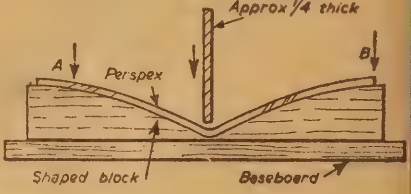


Fig. 3. Method of bending the Perspex.

When in a pliable state transfer the perspex quickly to the mould and apply pressure at the points shown first in the centre with a clean rod or the rounded edge of a thin piece of wood. Another pair of hands should assist by applying downward with two pads of smooth cloth a points A and B (Fig. 3).

It should be possible to get some sort of standard clip to fix the deflector to the bonne motif. Alternatively, suitable clips as shown in Fig. 4, could be made from strip brass. The deflector should be fixed so that it leans backward slightly, as shown in the illustration at the top of this page.

If the instructions are followed closely, the result should be as effective as the commercial deflectors now on the market both from th points of view of utility and smart appearance.

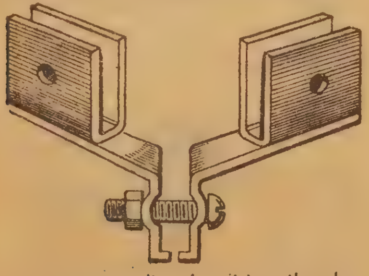


Fig. 4. Brass clips for fixing the deflector in place.

CHEAP CAR TO BE MADE IN ENGLAND

ENGLISH buyers are to be offered a three-wheeler car for £225.

This price includes sales tax, which is 50 pc of the wholesale price.

The car seats two adults and two children and is reputed to do 80 miles to the gallon.

First production models should be ready in March.

A Daily Express correspondent who rode in one of the cars——called a Gordon—says it has a frame of tubular steel and an aluminium body.

Overall length is 10ft and width 4ft 9in.

Body panels can be removed by unbolting six nuts.

He says it should give motoring at three-farthings a mile for a family of four.

The R & H Telephone amplifier

(Continued from Page 65)

vith the insulating spacers, then cut pproximately ¼in off the spacers to rovide new terminals.

The final adjustment of the relay osition should be made using a tandard handset, and the high and ow tension circuits should be hecked with a meter to ensure that hey really do switch off when the andset is lifted. On the other hand, he amplifier should operate posi-ively when the handset drops into lace, without the need for any uggling with the hook. Slight elon-ation of the relay mounting holes n the front of the case will assist n placing the relay where required.

With the relay working correctly, he remaining units—speaker, ampli-ier, batteries, &c.—may be fitted into he case and the device tested. A andset hung in position should roduce the normal dial tone in the peaker, and dialling one's own num-er will produce the engaged signal. This should be quite strong. If feed-ack occurs or appears likely, the ain should be reduced until the ystem is stable.

The performance of the horn is argely dependent on the efficiency f the particular circuit, and it must e realised that some losses are in-vitable. For this reason circuits vhich are perfectly satisfactory in he normal way may not be suit-ble for this form of operation and, f it is obvious that the other party s having difficulty in hearing, the normal form of operation should be used.

In noisy locations greater forward oncentration of the received signal an be obtained by fitting a small leflecting vane above the speaker grill at approximately 45 degrees.

And that's about all there is to it. n any office, such a device will rove a marvellous work aid. It hould pay for itself in a few weeks n the time it saves by releasing per-onnel who would otherwise hained to the phone—wastefully—or many hours per week.

Scotch Boy Magnetic Recorder Tape

MC III 1,200ft x ¼in

52/6 per reel

POST FREE

14 and 18mm Pyrox Spark Plugs 4/6 ea.

4—17/6, 6—24/6, 8—32/-.

MAIL ORDERS POST FREE

Discount to Garages arranged.

D. MITCHELL
223 OXFORD STREET,
SYDNEY—FA3658

IN THE WORKSHOP
FOR MOTORISTS
FOR SERVICEMEN
FOR THE HANDYMAN
IN INDUSTRY
SCOPE LABORATORIES MELBOURNE

Only SCOPE can solder so many Jobs.. SO WELL!

EVERYWHERE . . . in factory, laboratory and privately, for heavy and light work, the amazing Scope Soldering Iron is giving speedy, efficient service.

After only six seconds heating, every soldering job, whether it's delicate instrument work or heavy duty, is accomplished in a matter of seconds with minimum of effort and use of power.

Operating on a voltage range of 2.5/6.3 AC or DC, (thereby ensuring complete safety), Scope can be operated from a car battery OR from AC mains with National Transformer (optionally supplied).

To fully appreciate Scope, test it yourself at your local supplier, and you will agree that Scope is really remarkable value

Price 50/-

National Transformer, 47/11

SCOPE SOLDERING IRONS

THE CHEAPEST AND MOST EFFECTIVE ETCHING TOOL ON THE AUSTRALIAN MARKET

VIBROSCOPE

Combining mechanical vibration with electrical action, VIBROSCOPE indelibly marks all metals, ferrous and non-ferrous, of dull or bright finish. Operates from Scope's Iron Transformer, or AC/DC sources between 3 and 4 volts.

Price 35/-

N.Z. Distributor: H. W. Clarke, Auckland and Wellington.

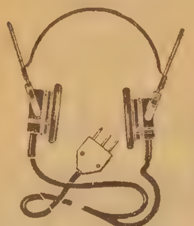
Australian & Overseas Agents:

WM. J. McLELLAN & CO. PTY. LTD.

126 Sussex St. (just North of King St.), Sydney. BX 1131

MANUFACTURED BY SCOPE LABORATORIES, MELBOURNE, VICTORIA

MOTOR SPARES LTD



HEAD-PHONES

We have stocks of the following Headphones, both are brand new and boxed in perfect condition.

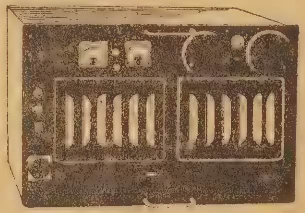
GERMAN HIGH IMPEDANCE PHONES (illustrated)

Impedance 4000 ohms; adjustable for maximum output and clarity; light weight, each fitted with cord and plug. A very fine phone, ideal for crystal sets and for any other purpose. Worth £4/10/-. Weight 1¼lb.

Our price 39/6.

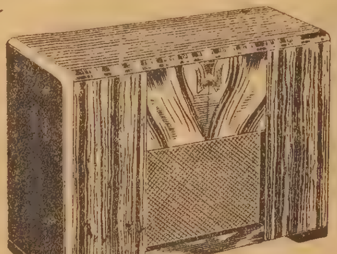
ENGLISH LOW IMPEDANCE PHONES

Robustly constructed and efficient in operation, fitted with cord and plug. Worth £2. **Our price 18/6.**



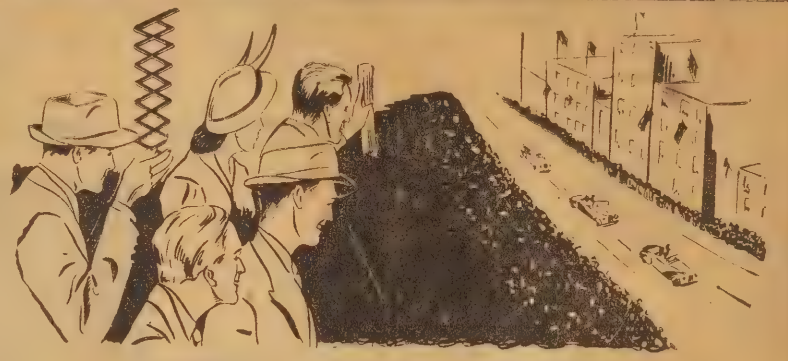
AT 300 TRANSMITTER

Radar Transmitter uses the following parts:—3—AV11 valves, 2—cyclatron valves, 2—4 ceramic socket, 1—24 volt motor, 2—01-5000 volt working condenser, 1—02-10,000 volt working condenser, 1—001-5000 volt mica condenser, 3—heavy duty transformers, 1—0-100 volt AC meter which is 0-1 MA movement with 1 MA dry metal rectifier fitted, 1—0-5 MA, DC, meter, and many other parts, such as stand off insulators, coils, etc. Worth £30. **OUR PRICE £4/19/6. Weight 80lb.**



RADIO CABINETS

We have an extensive range of Radiogram Cabinets available in Walnut, Mahogany or Blonde woods in nicely matched veneers. You can easily convert your old console or mantel radio to the latest in radiograms by fitting it to one of these cabinets with a Microgroove Record Changer or Player. Price from £15/10/- for the model illustrated. Other models available both front opening and lift up lid types. Prices and Photos on application.



HURRY! HURRY! HURRY!

Don't wait until the Royal Party arrives; secure a Periscope now and be sure of an unobstructed view in the largest crowd.

Price Only 12/6. Weight 2lb.

Dealers: Write for special price for quantities.

SPECIALS!

1. 0-50ma Meters:—Brand new English Meters boxed and perfect. Square dial with 2 inch scale. Ideal for multimeters, etc. Worth £3/10/-. Our price **18/6.**
2. 0-40 Volt Meters, similar to above. Price **19/6.**
3. 0-20 Volt Meters, similar to above. Price **19/6.**
4. 0-1ma Meters 1000 ohms per volt, square face 2 inch scale. An excellent meter for building up multimeters. Price **32/6.**
5. Baffle Boards polished size 24in x 18in suitable for 8in speakers especially designed for amplifier work. Worth 30/-. Our price **19/6.**
6. 80 ma Power Chokes 20 henry, brand new. Worth 35/-. Our price **19/6.**
7. English 3 speed Electric gramophone motors, suitable for standard and microgroove recordings. Only **£5/10/-.**
8. 12 volt non synchronous Vibrators. British made, brand new. **10/-** ea.
9. Rheostat, 250 ohm 25 watt wound on Mica with porcelain insulation. **4/6** each.
10. Rheostat, 100 ohm, Heavy Duty. **2/3** ea.
11. 4 mfd, 600 Volt Working Block Condensers. Well known brand, new. Worth 35/-. **Only 10/-.**
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Electro-flash design trends

(Continued from Page 85)

hed, the capacitor commencing to arge automatically immediately a ash is fired and, in most cases, eing fully charged again by the me the operator is ready for an-her shot. The convenience of ich an arrangement is easy to nagine.

There is also a worthwhile sav-g in weight because a suitable high oltage battery should weigh ap-roxiamtely the same as a low volt-ge battery in a vibrator system. hus, the weight of the transform-, vibrator, and minor components eliminated, and this can easily mount to 2lb or more in a high oltage system. As a result of all ese savings there appears to be very chance that the home con-tructor should be able to build a nit weighing not more than 6lb, nd still having a light output, in erms of exposure, equal to that of ur previous high voltage system.

NY CATCH

With so many advantages, appar-ntly for nothing, one may be tempt-d to ask, "Where's the catch?" As ar as we can see there is only ne, and even this may not always pply. It concerns the number of ashes which are likely to be stor-d in a typical battery and the pos-ibility of this number not being sed before the battery commences deteriorate due to so-called "shelf fe".

So far, we have no exact date regarding the running costs, though it would appear to work out at something between 1d and 2d per flash, depending on the rating of the unit. This being so it is likely that a battery will contain several hundred flashes and it would be advisable to use these within a period of about six months.

OCCASIONAL USE

For the worker who uses his equipment regularly this is not a severe restriction, but it may prove an objection for those who only do such work occasionally and who may, therefore, be forced to discard a battery after only 30 or 40 flashes.

For this reason it may be worthwhile considering some alternative forms of power supply, which would permit a smaller number of flashes to be purchased at one time. One suggestion is a transformerless voltage doubling system, which requires a battery of only half the voltage of the lamp.

This uses a vibrator cartridge and two smaller value capacitors to give the voltage doubling effect, and is particularly efficient. The only actual waste power is that used to drive the vibrator reed, and this is normally supplied from a small low voltage battery made from torch cells. The main disadvantage appears to be a longer charging time, though it may still be possible to keep this within reasonable limits.

Another approach, and one which is used in at least one imported commercial unit, is a reversion to the low voltage battery, vibrator, and transformer technique. In this case the unit weighs approximately 6lb, but it may not be possible for the home constructor to do quite as well as this with the components available at present.

The unit mentioned operates from a four-volt accumulator consisting of two of the smallest cells we have yet seen. They are not a "dry" type, but appear to be quite unspillable, and have, in addition, a built-in hydrometer in each cell. It is obvious that the use of this tiny battery makes for a major saving in weight.

SHOULD BE LIGHTER

It is also possible to effect some saving in the matter of the power transformer, since the low voltage types do not require many thousands of turns of wire and bulky insulation, and it is possible that the home constructor may score in this regard. There is still, of course, the very worthwhile saving made possible by the electrolytics so that such a unit must be lighter, even if it is not as light as the high voltage battery types.

It is also pleasing to note that the price of the new flash tubes is less than the older types, a tentative figure for a typical type being only a few shillings over £5, including sales tax. This fact, together with the elimination of the vibrator, transformer, and rectifiers, makes for a considerable saving in first cost, and a home-made unit for less than £20 would appear to quite feasible.

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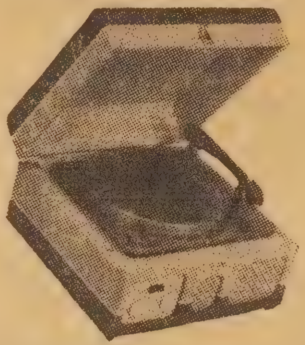

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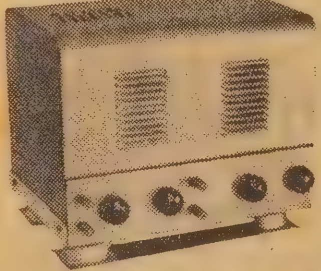

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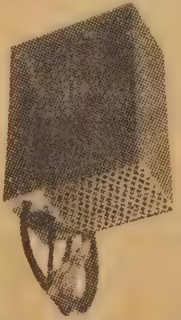

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ANSWERS TO CORRESPONDENTS

G.E. McI. (Wahroonga, NSW) writes to let us know that he has built both the 1951 and 1952 Little General receivers. He is very pleased with the performance of both.

A. It is certainly very gratifying to have received overseas stations on the broadcast band with such a relatively simple receiver. We cannot claim to have heard Okinawa on the broadcast band, but our listening times are restricted by pressure of other work. The morse interference with the 1952 Little General may originate from ships' transmitters operating on frequencies below the broadcast band. It is likely to be connected with the design of the aerial coil primary which may be resonant at the frequency of the interfering station. The cure may be to connect say a 50 pf condenser in series with the aerial lead. Glad to hear of your success with the other Radio & Hobbies projects.

R.C. (Mordialloc, Vic.) writes to suggest that we include a complete resistor color coding chart in our next issue.

A. Thanks for your letter R.C., but we point out that such a chart has been published in the magazine and if you wish, you may obtain reprints of the featured page through the 2/- query service. However, if space permits us, we will consider republishing the chart in a future issue.

J.V.R. (Abbotsford) was upset to see that we had no immediate plans for a senior signal tracer. He requests that we go ahead and design one.

A. The name Junior Signal Tracer was chosen with the idea that there may be some day a Senior version. However, the smaller one has proved so successful that the case for a more elaborate instrument did not seem so urgent. However, there may be other readers who think as you do. If so, we'd like to hear from them You might like to write again and suggest the features you'd like to see in a larger instrument. Such features would have to be listed against an actual need rather than just the inclination to have a lot of knobs and facilities with little real use in service.

J.M. (Bendigo, Vic.) adds his request, to that of a number of other readers, for a new edition of the Shortwave Handbook.

A. While we cannot promise a definite publication date, you can rest assured that the matter is not forgotten. We also have an Amplifier Handbook in mind.

A.D.S. (Sydney, NSW), asks if we can supply the circuit of a power supply which would enable a commercial portable receiver which he has on hand to be operated from the 240V AC power mains.

A. The "Personal" power supply, which was described in the October, 1948, issue of Radio and Hobbies should suit your purpose. It was originally designed to deliver a 67V high tension but a minor modification to the values of voltage divider components would enable it to deliver 90V if desired. The circuit is available through the 2/- query service in the usual way.

W.J.B. (North Perth, WA), refers to a battery operated modulated oscillator appearing in an early edition of Radio and Hobbies, namely the September, 1939, issue, and would like to know whether the constructional details on the AC version are available.

A. The AC version of the oscillator you mention, W.J.B., was published in the June, 1939, issue of Radio and Hobbies and used either a 57 (2.5 volt heater) or a 6C6 (6.3 volt heater) valve. However, the information available for this design is limited to the circuit only but, since you have the coil kit, there should be no reason why you cannot successfully build it up. Reprints of the circuit may be obtained through the query service.

G.D. (Glenthcote, Vic.) has a portable receiver which can be made to go in and out of operation by moving the 3S4 output valve in its socket. He would also like the names and addresses of firms willing to make special sets to customers' specifications.

A. It would appear that the small clamps which grip the valve pins in the socket are lacking in tension. You may be able to overcome the trouble by pushing a sharp instrument such as a scriber down into the socket alongside the clamp. Don't carry the operation too far otherwise you will run the risk of breaking the socket. Other than the firms that advertise in Radio and Hobbies, we cannot suggest anyone who would be able to make a special receiver for you.

C.H. (Perth, WA) encloses an encouraging letter with his subscription. He has followed the various articles with interest, particularly those on audio equi ment. However, he suggests that v make a volume expander the subject a future constructional article.

A. Many thanks for the subscriptio the favorable remarks and the suggestio There are a number of difficulties designing a satisfactory volume expande They are by no means insurmountab and it is possible that we will have som thing to say about them at a later dat There is a considerable amount of i formation on the subject in the four edition of the Radiotron Designers' Han book (Langford-Smith). You would pro ably be able to see it at a technical li rary. In point of fact, the need for volume expander is not very urgent wi the much improved dynamic range modern records.

B.L. (Newport, Vic.) is keen to sta out with radio as a hobby and par cularly to build a crystal set. He as our advice.

A. There are various radio cours advertised from time to time. If th idea appeals to you we suggest you che with the ads. in Radio and Hobbies a write to whichever of the radio scho appeals to you. We have published tv beginners' series in Radio and Hobbi either of which may interest you. T latest began in the August, 1952 iss and a crystal set was described in t following issue. Later articles in t series led up to the construction of three valve battery operated receiv capable of operating a speaker and tu ing shortwave stations. Previously, series began in the March, 1951 issu This series led from a crystal set to four valve AC operated superhet r ceiver. Unfortunately, none of the co structional articles is available fr this office. We can only suggest that y try to see them at a public libra The schematic circuits, wiring diagra and parts lists for the various sets a available through the 2/- query servi

K.J. McI. (Brisbane) requests a co of our alignment pamphlet and also poi out that at least one commercial recei he knows uses a large loop which co possibly be duplicated by hand.

A. The pamphlet has been forward as requested. We have not seen t particular set you mention but, in t meantime you will doubtless have se the instructions for winding the loop suit the Rambler. There is nothi patent about the design of any one lo but dimensions, number of turns, & inevitably vary with the shape and s of the set.

M.J.P. (Salisbury SA) requests so information regarding magnetic he for use on 9.5 mm. film.

A. We suggest that some of our a vertisers who supply such heads may ha been experimenting with these devi and may be able to help you. We su gest that you contact them direct. the same time we would raise the p sibility that your trouble may be the associated equipment rather th the heads since most tape heads, wh not ideally suited for the job, sho give reasonable results.

D.D. (Tallangatta, Vic.) raises eternal beginner's problem about direction of current flow. He also s gests that we publish more informat suitable for beginners.

A. You may take the following quite definite, D.D.: Electricity is movement of electrons, and electr flow from negative to positive. confusion arises due to mistakes m by early workers and which beca firmly established before they were covered. This problem was discus in greater detail in a recent Answer T article. Thanks for your suggestion garding the publication of terms, D but we doubt whether it would be sible to explain each adequately in a list. We have conducted several se designed specially for beginners we may have another one coming a shortly. We suggest that you follow many articles as you can in the meant and we think you will soon get the of the terminology.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

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Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

E WIDE-BAND SIX

(Continued from Page 35)

ned through this spot. You will
bly notice a small "peak" set
le to each side of the centre
g point.

the oscillator to 1200 Kc, tune
et to it and readjust the trim-
across the two aerial sections
e gang. Remove the service
ator, connect the aerial, and
check these trimmers to correct
ading by the aerial itself.

you have no service oscillator,
bout the alignment in this
n:

h the selectivity switch set to
'normal" position, couple the
to the grid of the 6AN7 and
n a station around 600 Kc.
fy it and, if necessary, adjust
scillator coil slug until it is
at its correct spot on the dial.
ct the aerial to its terminal, set
vitch to the "wide-band" posi-
nd roughly adjust the aerial
ugs for maximum response.

the switch back to "normal"
ne in a station around 1200 Kc.
t the oscillator and aerial trim-
until it is being tuned at its
t spot and at best strength.

ct a fairly weak station away
the low frequency end of the
nd adjust the slugs in the IF
ormers for maximum response.

ou find that some of these ad-
nts are a little broad, note the
ns of the slug where the signal
egins to drop, and set the slug
point halfway between them.

COILS

with the switch at "wide-
and the aerial coupled to the
grid, carefully tune in a station
600 Kc. Transfer the aerial
terminal. Adjust the slug in
aerial coil with the other
d with a .025 megohm resistor
same manner as mentioned
using a service oscillator. Re-
the resistor.

g the dial to a station, prefer-
weak one, toward the high
ncy end of the dial, and check
ljustment of the aerial coil
ers for maximum response,
the cores strictly alone.

ou are using received signals
nment, the only way in which
reduce their level to avoid
AVC action is to use tem-
a short length of wire for
rial or to remove the normal
and wrap it for a few turns
the aerial terminal.

alignment procedure may
nvolved at first reading, but
ou have had a practice run
ll find it simple enough.

but not least is the simple ad-
nt of the 10 Kc whistle filter.
et the .1 megohm potentio-
o about .02 megohm with the
multimeter and, while listen-
the 10 Kc adjacent channel
with full treble boost, adjust
g in the whistle filter inductor
e whistle level drops. With
te adjustments of the poten-
r and inductor slug, you will
at the whistle will disappear.

n you are quite happy with
nment adjustments, seal all
nd trimmers with wax, nail
or coil dope.

OFF THE RECORD

(Continued from Page 95)

Baroque Ensemble, conducted by Karl Haas. Westminster WL5174.

As the annotations on the jacket rightly point out, the Brandenburg Concertos are often spoiled by being played by large orchestras in which their delicate structure and authentic intimacy are lost. The LP technique as exploited by Westminster allows the full presence of instruments to be heard, the lack of surface noise giving effect to the full dynamic range required by such recording. And the harpsichord, the presence of which is vital to the ensemble, no longer sounds like a doctored piano. The solo in the first movement of No. 5 reproduces the harpsichord as authentically as I have ever heard it.

No. 3 opens somewhat slower than I like, as is usual, but after all, there is really no hard and fast time with music of this type.

The recorded range is quite wide, and gives timbre to all instruments. It plays cleanly with the merest hint of deterioration at the end of No. 5, which might even have been due to the stylus.

In summary, delightful performance — one of Westminster's best.

SCHUBERT—Trio in E Flat Major, Opus 100, played by Jean Fournier, Antonio Janigro and Paul Badura-Skoda. Westminster WL5121.

This is the same combination which produced the fine performance of the "Archduke" trio reviewed some time ago. This, technically, is an even better disc, and I would be hard put to it to find a blemish. I doubt whether there are better and more convincing chamber music records being released today than these. All three instruments are heard just about as intimately as they can be in such a small ensemble, and there is scarcely a note which cannot be followed with the score. The strings bite as they should, there is no undue edge to the violin, the cello is relaxed and in perfect tune, the piano balanced against them in faultless style, even in the frequent pianissimo — a tribute to the recording engineer as much as to the players.

The trio itself, I don't regard as Schubert's best. It is simple in its matter, reminiscent in places and in treatment of other Schubert scores as is the rule rather than the exception. But with such good playing and clean recording, it is altogether delightful, and no one could fail to respond to its sunny mood. The surface at its worst is only just audible, and would not even be noticed if the dynamic range were not so wide.

Wanted to Buy, Sell or Exchange

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for March issue of Radio and Hobbies is Wednesday, February 3.

FOR SALE: BC348 £20, R1155 P/Supply £20, AWA 2in CRO £25, transmitting tubes, all types, STC AMR300 Vibrator, supply all spares, £10. Must sell. **Frazer, 24 Morton St., Queanbeyan.**

FOR SALE: Wireless gear, new, obsolescent and junk, is offered by old ham retiring from the game. Bargain price. Should interest beginners. Write **6 Wallaway St., Concord West or phone UF1197, Sydney.**

FOR SALE: Soundmirror Tape Recorder Deck, fast forward, etc., £60 or best offer. Also AR7 receiver, 500 Kc to 32 Mc. Wanted to buy or exchange above for good Communication Receiver, band switched (not AR7 type), JK3BU, W. **Brownhill, 71 Gheringhap St., Geelong. Ph. 5674.**

FOR SALE: Tape-heads H.T. and S.T. R/P and Erase; BSR and F.H.P. motors, pulleys, clutches, capstans, used, good order. Univ. 4in meter, 1mA V.T.V.M. scale, new power trans., asst'd coils Rola 6H, 600 trans. Rola 6-9L, Rola 12K, case for tape recorder 12in x 9in panel; must sell. Write for details. Wanted Rola 12U. **S. Dogger, Box 348, Broken Hill.**

SELL: R. & H., mostly 1943 to 1949, some earlier, £1 the lot, or sell separately. **18 Platts Avenue, Belmore.**

SELL: Ferguson Op. 25 trans. 10,000/12/3 £4. PF. 130 285v. 100mA £2, power rect. 500v. 250mA. with 5R4gy £5. **WM1647.**

SELL: World Radio Handbook, 1954 Edition, has everything about all short-wave and most broadcast stations, 9/- posted, **Arthur Cushen, 212 Earn St., Invercargill, N.Z.**

SELL: Stamps, 10 large Canadian pictorials 1/3, 12 USA pictorials 1/3. **C. A. Brown, Box 12, P.O., Lidcombe, NSW.**

SELL: 35m. 400 watt Projector, with 60 films, £20. **Douglass, Tiral St., Charlestown.**

SELL: 2-speed 16in cast Aluminium Turntable & BRS. Sync. Motor. Ideal recording setup, £35 or offer. **42 Mark St., Coburg, Vic. FM4284.**

SELL: Simon Complete Portable Disc Recorder, overhead traverse, V.P. Scrolling Device amp. 25. c/s to 20K/cs, Torsion Bar Head beautifully cased, chrome fittings as new. Cost £250. Sacrificed £135. **JA7140.**

SELL: Radio suit Dodge car, ute, or similar. Powerful, £20. **LX5953. 5 Carrington St., Bexley.**

SELL: Transceiver 20W, Commando Type 3, Mk. 2, 240v. A.C. or battery as new. Spare valves, 3½ to 15 Mcs., with two 7 Mcs. xtals, £22. AWA wavemeter, class in C, No. 1 (Aust.) as new, spare vibrator and valve, £12. **XM6587.**

SALE: Gramo Tape Recorder Kit, £18. 12in Magnovox P.M. Speaker, 50/-. **Hunt, 16 Brennan St., Leichhardt.**

SALE: 4-valve Portable, 7in Speaker, £15 or offer. Parts, gangs, power transformer, etc., chemical apparatus, chemicals. **191 Bruce St., Merewether, Newcastle.**

WANTED: AR7 complete with coil boxes. Alternatively Hallicrafter Edystone or similar com. receiver. Particulars to **B. Joan, Box 9, Port Adelaide.**

WANTED AT5-AR8 Type "S" Power Supply, complete with tubes in good condition—no fancy prices—**R. W. George, 3 Morris Street, Cootamundra.**

WANTED urgently: FS6 Transceiver, complete and in good order. **W. Mayne, High St., Hastings, Vic.**

WANTED: R. & H., Vol. 14, Nos. 5-6-7-8-12, and Vol. 15, No. 1. **Keenan, Roadside Delivery, Neerin Sth., Vic.**

WANTED: F36 Power Packs, state price required. **M. S. Jackman, Box 100, Casterton, Vic.**

EXCH.: MT 119 Mod. Xformer as new for output Xformer, OP 18 or similar, **Smith, 32 William St., Forbes, N.S.W.**

AUSTRALIAN BROADCAST STATIONS

A COMPLETE LIST OF NATIONAL AND COMMERCIAL STATIO

(Projected stations have been omitted.)

Call Sign	Location	Frequency (Kc/s)	Wave-length (Metres)
4QL	Longreach, Qld.	540	556
2CR	Cumnock, NSW	550	545
7BW	Burnie, Tas.	560	536
6WA	Minding, WA	560	536
3WV	Dooen, Vic.	580	517
4QR	Brisbane, Qld.	590	508
7ZL	Hobart, Tas.	600	500
2FC	Sydney, NSW	610	492
3AR	Melbourne, Vic.	620	484
4QN	Cleveden, Qld.	630	476
5CK	Crystal Brook, SA	640	469
2NW	Manilla, NSW	650	462
2BH	Broken Hill, NSW	660	455
2CO	Corowa, NSW	670	448
2HR	Lochinvar, NSW	680	441
4AT	Atherton, Qld.	680	441
4KQ	Brisbane, Qld.	690	435
6WF	Perth, WA	690	435
2NR	Lawrence, NSW	700	429
7NT	Kelso, Tas.	710	423
7QT	Queenstown, Tas.	720	417
2TR	Taree, NSW	720	417
4QA	Mackay, Qld.	720	417
6GF	Kalgoorlie, WA	720	417
5CL	Adelaide,	730	411
2BL	Sydney	740	405
4QS	Dalby, Qld.	750	400
2NB	Broken Hill, NSW	760	395
3LO	Melbourne, Vic.	770	390
2KA	Katoomba, NSW	780	385
4TO	Townsville, Qld.	780	385
4QG	Brisbane	790	380
5RM	Renmark, SA	800	375
6WN	Perth, WA	810	370
2NA	Newcastle, NSW	820	366
3GI	Longford, Vic.	830	361
6GN	Geraldton, WA	830	361
4RK	Rockhampton, Qld.	840	357
2CY	Canberra, ACT	850	353
4GR	Toowoomba, Qld.	860	349
7HO	Hobart, Tas.	860	349
2GB	Sydney, NSW	870	345
3UL	Warragul, Vic.	880	341
4WK	Warwick, Qld.	880	341
6PR	Perth, WA	880	341
5AN	Adelaide, SA	890	337
2LM	Lismore, NSW	900	333
7AD	Devonport, Tas.	900	333
6BY	Bridgetown, WA	900	333
4QB	Pialba, Qld.	910	330
2XL	Cooma, NSW	920	326
4VL	Charleville, Qld.	920	326
5NA	Narrogin, WA	920	326
3UZ	Melbourne, Vic.	930	323
4QY	Cairns, Qld.	940	319
7ZR	Hobart, Tas.	940	319
2UE	Sydney	950	316
3BO	Bendigo, Vic.	960	313
4AY	Ayr, Qld.	960	313
6TZ	Bunbury, WA	960	313
5DN	Adelaide, SA	970	309
2KM	Kempsey, NSW	980	306
6AM	Northam, WA	980	306
2GZ	Orange, NSW	990	303
3HA	Hamilton, Vic.	1000	300
4RO	Rockhamtpon, Qld.	1000	300
4CA	Cairns, Qld.	1010	297
6GE	Geraldton, WA	1010	297
4IP	Ipswich, Qld.	1010	297
7EX	Launceston, Tas.	1010	297
2KY	Sydney	1020	294
3DB	Melbourne	1030	291
5PI	Crystal Brook, SA	1040	288
2CA	Canberra, ACT	1050	286
4SB	Kingaroy, Qld.	1060	283
2RG	Griffith, NSW	1070	280

Call Sign	Location	Frequency (Kc/s)
6WB	Katanning, WA	1070
2MO	Gunnedah, NSW	1080
7HT	Hobart, Tas.	1080
3LK	Lubeck, Vic.	1090
4LG	Longreach, Qld.	1100
6MD	Merredin, WA	1100
7LA	Launceston	1100
2UW	Sydney	1110
4BC	Brisbane, Qld.	1120
2AD	Armidale, NSW	1130
3CS	Colac, Vic.	1130
6PM	Perth, WA	1130
2HD	Newcastle, NSW	1140
2WG	Wagga Wagga, NSW	1150
4MB	Maryborough, Qld.	1160
2CH	Sydney, NSW	1170
3KZ	Melbourne, Vic.	1180
2NZ	Inverell, NSW	1190
5KA	Adelaide, SA	1200
2GF	Grafton, NSW	1210
3YB	Warrnambool, Vic.	1210
6KG	Kalgoorile, WA	1210
4AK	Oakey, Qld.	1220
2NC	Newcastle, NSW	1230
3TR	Sale, Vic.	1240
6IX	Perth, WA	1240
2DU	Dubbo, NSW	1250
9PA	Port Moresby, NG	1250
3SR	Shepparton, Vic.	1260
2SM	Sydney	1270
3AW	Melbourne, Vic.	1280
4BK	Brisbane, Qld.	1290
2TM	Tamworth, NSW	1300
5AD	Adelaide, SA	1310
3BA	Ballarat, Vic.	1320
6KY	Perth, WA	1320
3SH	Swan Hill, Vic.	1330
4BU	Bundaberg, Qld.	1330
2LF	Young, NSW	1340
6CI	Collie, WA	1340
3GL	Geelong, Vic.	1350
4GY	Gympie, Qld.	1350
2NX	Bolwarra	1360
5SE	Mt. Gambier, SA	1370
2LT	Lithgow, NSW	1370
2GN	Goulburn, NSW	1380
4MK	Mackay, Qld.	1380
4BH	Brisbane, Qld.	1390
2PK	Parkes, NSW	1400
5AU	Port Augusta, SA	1400
2KO	Newcastle, NSW	1410
3XY	Melbourne, Vic.	1420
2WL	Wollongong, NSW	1430
2MW	Murwillumbah, NSW	1440
3CV	Maryborough, Vic.	1440
2MG	Mudgee, NSW	1450
7DY	Derby, Tas.	1450
5MU	Murray Bridge, SA	1460
3MA	Mildura, Vic.	1470
2BE	Bega, NSW	1480
4ZR	Roma, Qld.	1480
2AY	Albury, NSW	1490
2BS	Bathurst, NSW	1500
3AK	Melbourne, Vic.	1500
5DR	Darwin, NT	1500
2QN	Deniliquin, NSW	1520
5LN	Pt. Lincoln, SA	1530
5AL	Alice Springs, SA	1530
2CN	Canberra, ACT	1540
2RE	Taree, NSW	1560
2LG	Lithgow, NSW	1570
4GM	Gympie, Qld.	1570
5WM	Woomera, SA	1580
4SO	Southport, Qld.	1590